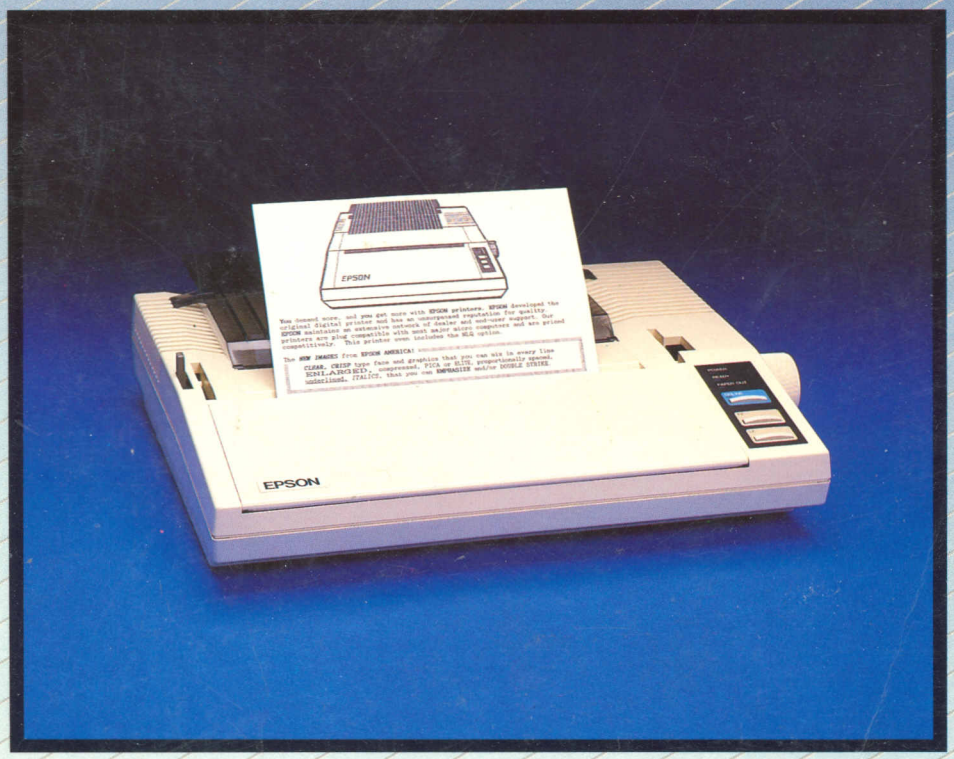
EPSON®

Operating Manual



LX-80 Printer

P8492037-0
Y560991020

EPSON®

LX-80 PRINTER

Operating Manual

FCC COMPLIANCE STATEMENT FOR AMERICAN USERS

This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

— Reorient the receiving antenna
— Relocate the computer with respect to the receiver
— Plug the computer into a different outlet so that computer and receiver are on different branch circuits.

If necessary, the user consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

"How to Identify and Resolve Radio-TV Interference Problems."

This booklet is available from the U.S. Government Printing Office, Washington DC 20402. Stock No. 004-000-00345-4.

WARNING

The connection of a non-shielded printer interface cable to this printer will invalidate the FCC certification of this device and may cause interference which exceeds the limits established by the FCC for this equipment. If this equipment has more than one interface connector, do not leave cables connected to unused interfaces.

NOTICE:

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Introduction

The Epson LX-80 printer combines low price with the high quality and advanced features formerly available only on more expensive printers.

LX-80 Features

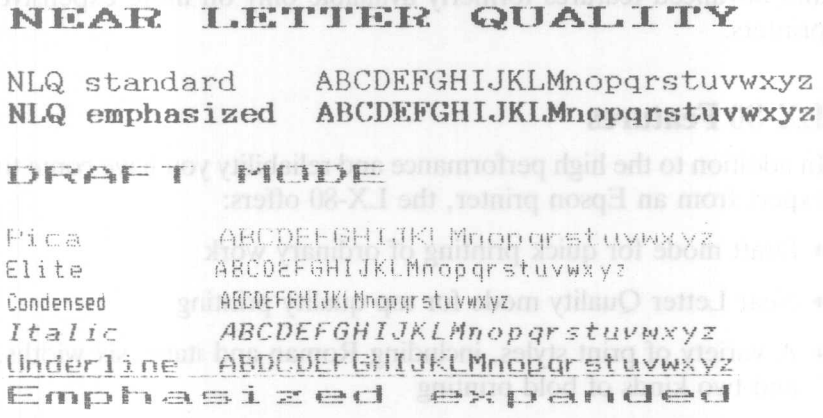
In addition to the high performance and reliability you have come to expect from an Epson printer, the LX-80 offers:

- Draft mode for quick printing of ordinary work
- Near Letter Quality mode for top quality printing
- A variety of print styles, including Roman and italic, six widths, and two kinds of bold printing
- User-definable characters so you can create and print your own symbols or characters
- High-resolution graphics for charts, diagrams, and illustrations
- Eleven international character sets
- Easy paper loading
- Ribbon cassette for quick and clean ribbon changing

Using This Manual

This manual contains all the information you need to use the LX-80. The more technical information is in the appendices. The main body of the manual is concerned mainly with a detailed explanation of how to use the commands to their best effect. If you have problems, or simply wish to have an in-depth description of a particular function, refer to the index.

As a preview of the type of output you can obtain from your LX-80, the following shows just a few of the functions.



Chapter 1
Setting Up Your LX-80 Printer

Setting up your LX-80 printer is a simple matter of attaching two parts, fitting the ribbon cartridge, inserting paper, and connecting the printer to your computer.

This chapter will first show you how to print a test pattern and then lead you into doing more complicated work. Familiarisation should not take more than about twenty minutes. For the moment do not plug in or turn on your printer.

Printer Parts

First, see that you have all the parts you need. In addition to this manual, the printer box should contain the items shown in Figure 1-1.

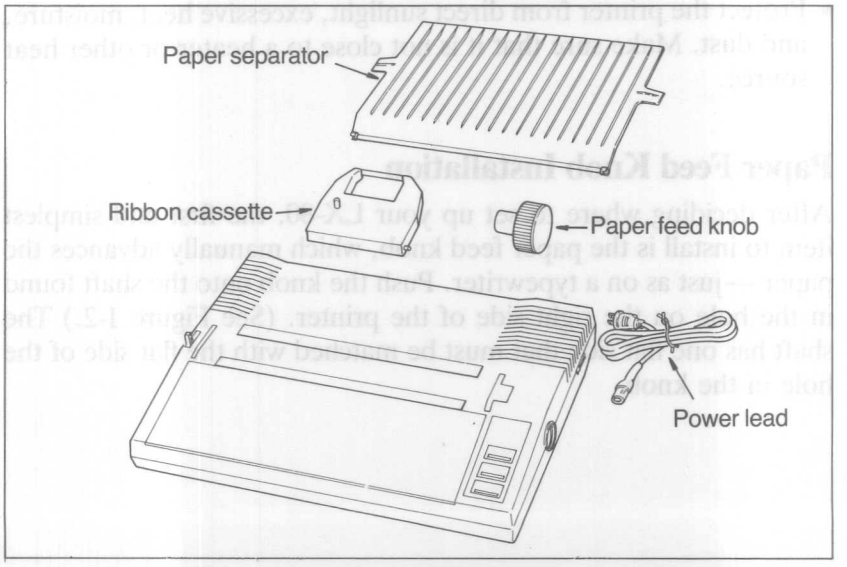


Figure 1-1. Printer parts

In addition to the items in the box, you need a cable and possibly an interface board. The cable connects the printer to your computer, and the interface board is necessary only for those computers that cannot use the LX-80's Centronics® parallel interface. Your computer manual or your dealer will tell you which cable you need and whether or not you need a special interface.

Printer Location

Now that you have unpacked your printer, you should choose a suitable location for it. The main requirement, of course, is that the printer be close enough to your computer for the cable to reach. Also remember the following:

- Use an earthed socket, and do not use an adapter plug.
- Be careful when using electrical sockets that are controlled by wall switches. Accidentally turning off a switch can wipe out valuable information in your computer's memory and disrupt your printing.
- Avoid using a socket on the same circuit as any large electrical machines or appliances. These can cause disruptive power fluctuations.
- Keep your printer and computer away from base units for cordless telephones.
- Protect the printer from direct sunlight, excessive heat, moisture, and dust. Make sure that it is not close to a heater or other heat source.

Paper Feed Knob Installation

After deciding where to set up your LX-80, the first and simplest item to install is the paper feed knob, which manually advances the paper —just as on a typewriter. Push the knob onto the shaft found in the hole on the right side of the printer. (See Figure 1-2.) The shaft has one flat side that must be matched with the flat side of the hole in the knob.

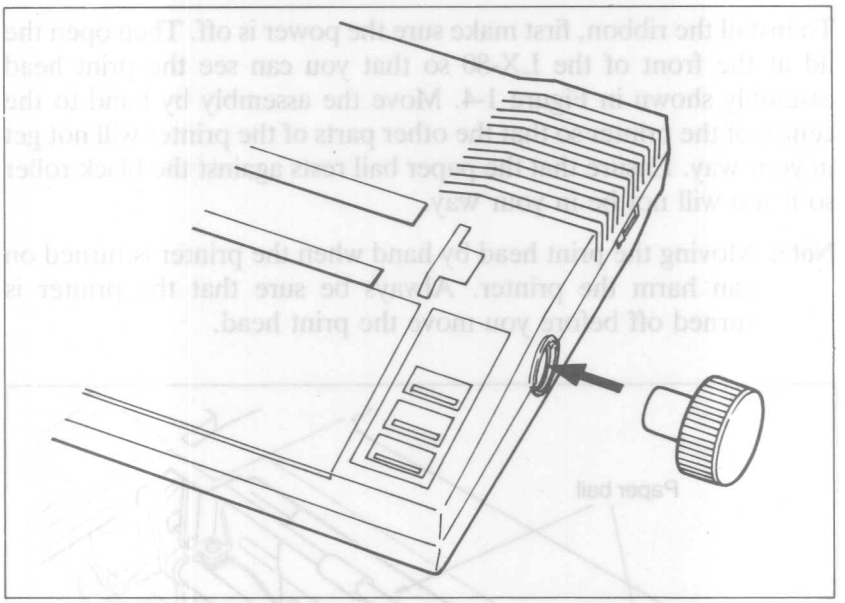


Figure 1-2. Paper feed knob installation

Ribbon Installation

The LX-80 printer uses a continuous-loop, inked fabric ribbon, which is enclosed in a cassette making ribbon installation and replacement a clean and easy job. The parts of this cassette are labelled in Figure 1-3.

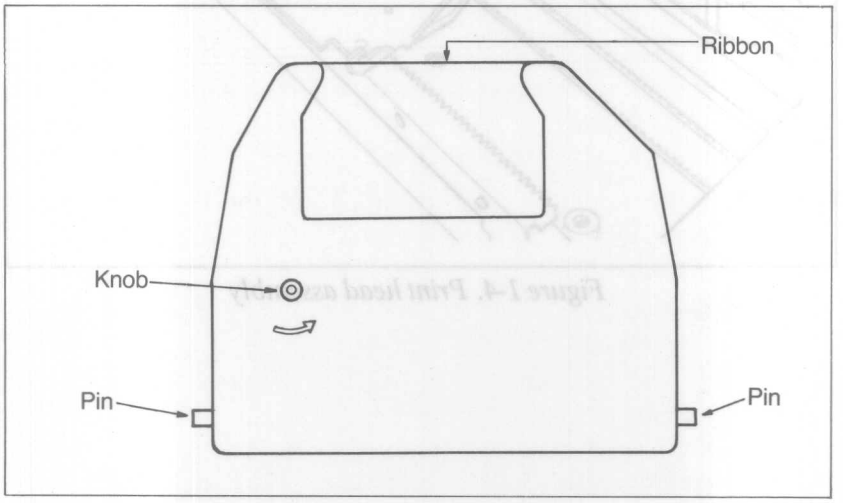


Figure 1-3. Ribbon cassette

To install the ribbon, first make sure the power is off. Then open the lid at the front of the LX-80 so that you can see the print head assembly shown in Figure 1-4. Move the assembly by hand to the centre of the printer so that the other parts of the printer will not get in your way. Ensure that the paper bail rests against the black roller so it too will not be in your way.

Note: Moving the print head by hand when the printer is turned on can harm the printer. Always be sure that the printer is turned off before you move the print head.

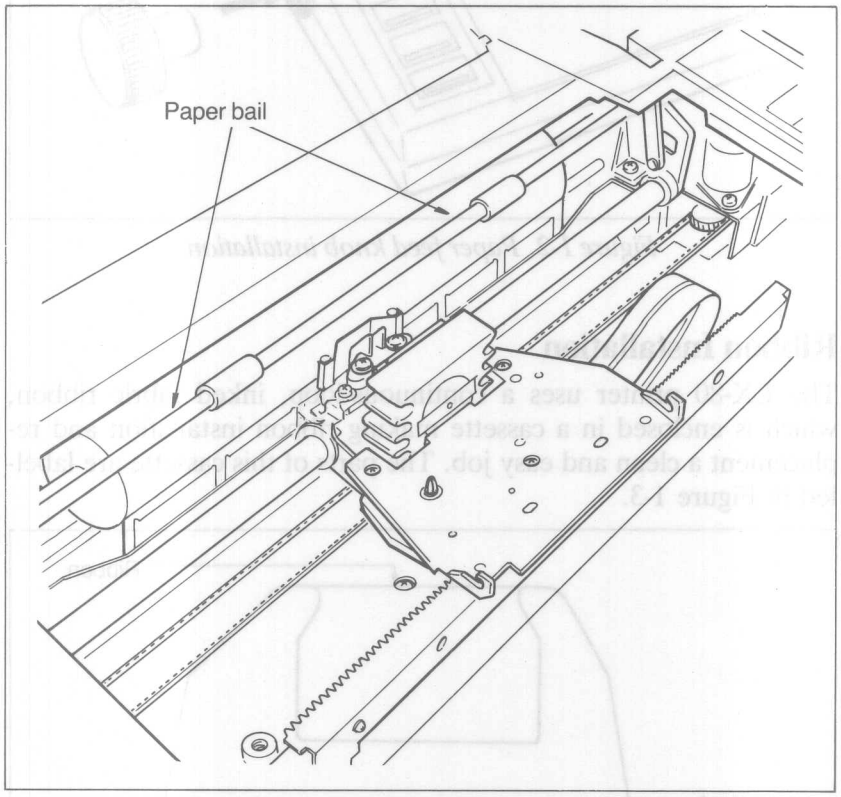


Figure 1-4. Print head assembly

Hold the ribbon cassette so that the small knob is on top and the exposed section of ribbon is away from you. Insert the cassette in its holder by first sliding the pins at the back of the ribbon cassette under the small hooks on the holder. (See Figure 1-5.) Then lower the front of the cassette so that the exposed section of ribbon can fit between the print head nose and the silver ribbon guide. Push down until the cassette fits firmly in place.

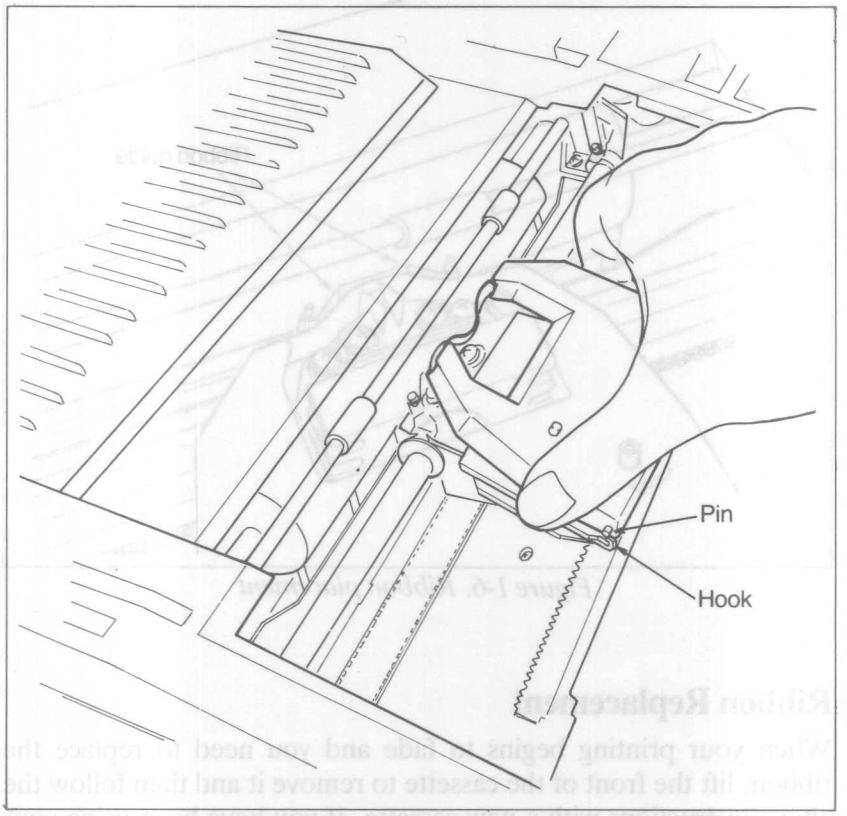


Figure 1-5. Ribbon cassette installation

Now turn the knob on the cassette in the direction of the arrow to take up the ribbon slack. As you turn the knob, see that the ribbon runs correctly between the print head nose and the silver ribbon guide (Figure 1-6). If it doesn't, guide it with a pen or a pencil.

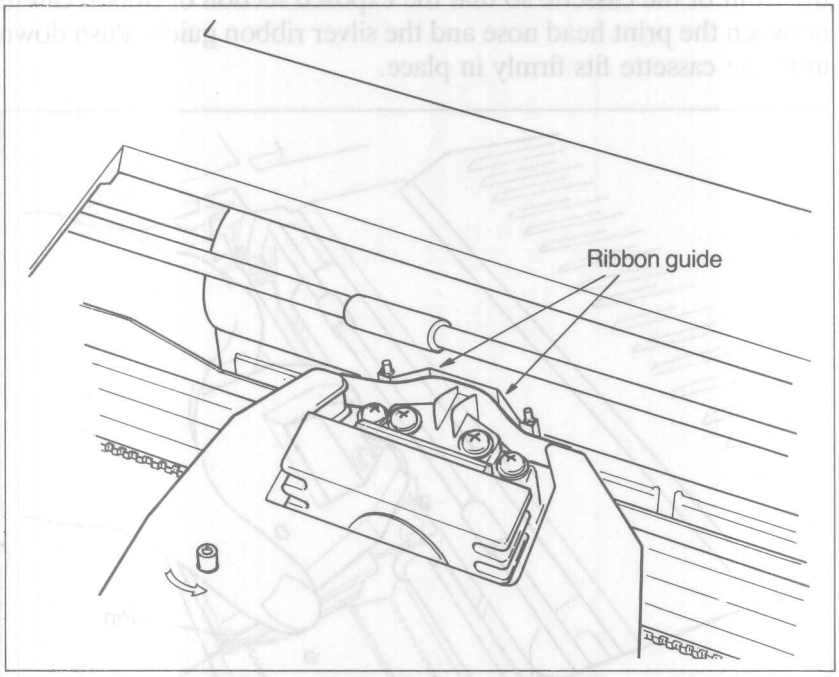


Figure 1-6. Ribbon placement

Ribbon Replacement

When your printing begins to fade and you need to replace the ribbon, lift the front of the cassette to remove it and then follow the above instructions with a new cassette. If you have been using your printer just before you change cassettes, be aware that the print head becomes hot during use. Be careful not to touch it. Also remember never to move the print head by hand when the printer is turned on.

Paper Loading

Now put a sheet of paper in your LX-80 so that you can test it. Figure 1-7 shows the names of the parts that you need to know.

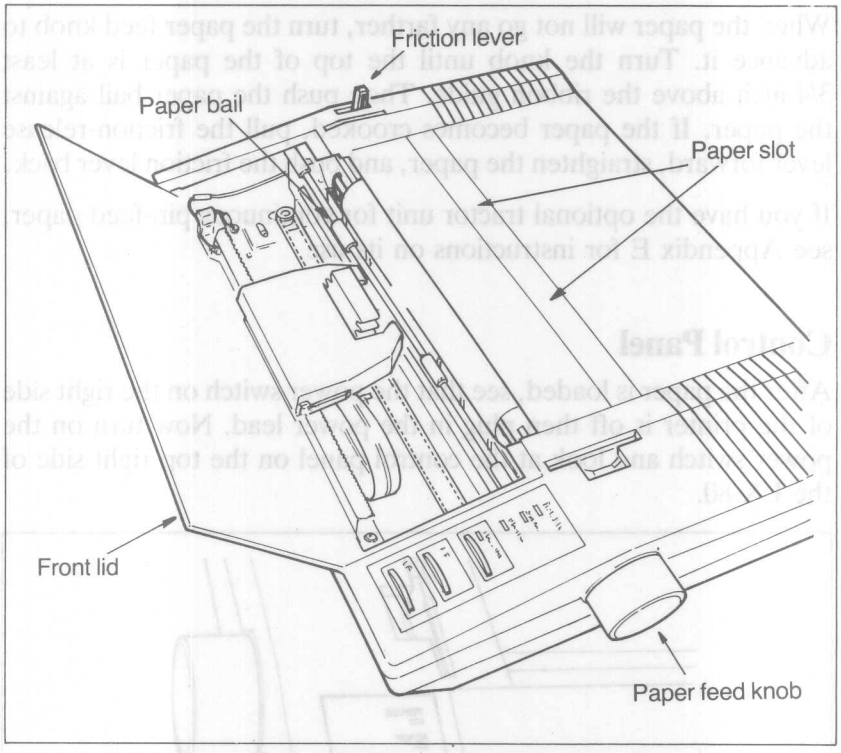


Figure 1-7. LX-80 ready for paper loading

See that the printer is turned off, open the front lid, and push the friction lever back and the paper bail forward. Then move the print head by hand to the centre of the printer and feed the paper into the paper slot in the top of the printer.

When the paper will not go any farther, turn the paper feed knob to advance it. Turn the knob until the top of the paper is at least 3/4-inch above the ribbon guide. Then push the paper bail against the paper. If the paper becomes crooked, pull the friction-release lever forward, straighten the paper, and push the friction lever back.

If you have the optional tractor unit for continuous pin-feed paper, see Appendix E for instructions on its use.

Control Panel

After the paper is loaded, see that the power switch on the right side of the printer is off then plug in the power lead. Now turn on the power switch and look at the control panel on the top right side of the LX-80.

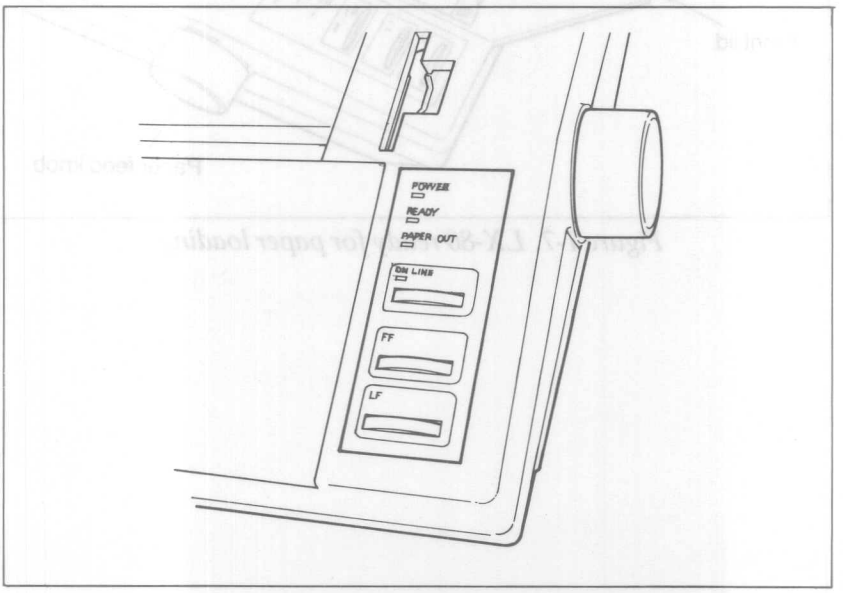


Figure 1-8. Control panel

There are several buttons and indicator lights on the control panel. Their primary functions are described below:

- The POWER light glows green when the power is on.
- The READY light glows green when the printer is ready to accept data. This light also flickers somewhat during printing.
- The PAPER OUT light glows red to indicate that the printer is out of paper or the paper is loaded incorrectly.
- The ON LINE light glows green when the printer can receive data.
- The ON LINE button switches the printer between on-line and off-line status. When the printer is on-line, the ON LINE light glows and the printer is ready to accept data.

The following two buttons work only when the printer is off-line. If the ON LINE light is on, press the ON LINE button to put the printer off-line before you use these buttons.

- The FF (Form Feed) button advances the paper to the top of the next page.
- The LF (Line Feed) button advances the paper one line at a time.

The control panel buttons can also be used to turn on several printing functions using a feature called SelecType, which is described in Chapter 2. In addition, you will find another use for the LF and FF buttons in the next section.

Test Pattern

The LX-80 can print a test pattern even when not yet connected to a computer. Ensure that the printer has paper in it and that the power switch is off. Hold down the LF button on the control panel while you turn the printer on with the power switch. The LX-80 will begin printing all the letters, numbers, and other characters that are stored in its ROM (Read Only Memory) for the draft mode. When the printing starts, you can release the LF button; the printing will continue until you turn the printer off or until the print head gets near the end of the page. To see the same test in the NLQ (Near Letter Quality) mode, turn the printer on while holding down the FF button.

Partial results of both tests are shown in Figure 1-9.

Figure 1-9. Test patterns

Connecting the LX-80 to Your Computer

Now that the test pattern has shown that your printer is working well, it is time to connect it to your computer. It is best to have both printer and computer turned off when you do this.

Remember that each computer system has its own way of communicating with a printer. If your computer expects to communicate through a Centronics parallel interface, all you need is a cable. If your computer requires any other kind of interface, you will also need an interface board.

If you do not know what a Centronics parallel interface is, your computer manual or your dealer will tell you what you need. Then, once you have plugged your printer cable into your printer and computer, you will probably never think about interfaces again. (If you do want the technical specifications, however, you can find them in Appendix I.)

The first three steps in connecting your printer and computer are shown in Figure 1-10. Plug one end of your printer cable into the cable connector of your LX-80 printer. The D-shape ensures that there is only one way it will fit the connector. Now secure the plug to the printer with the wire clips on each side of the connector. If your cable has an earthing wire, attach it to the earthing screw below the connector.

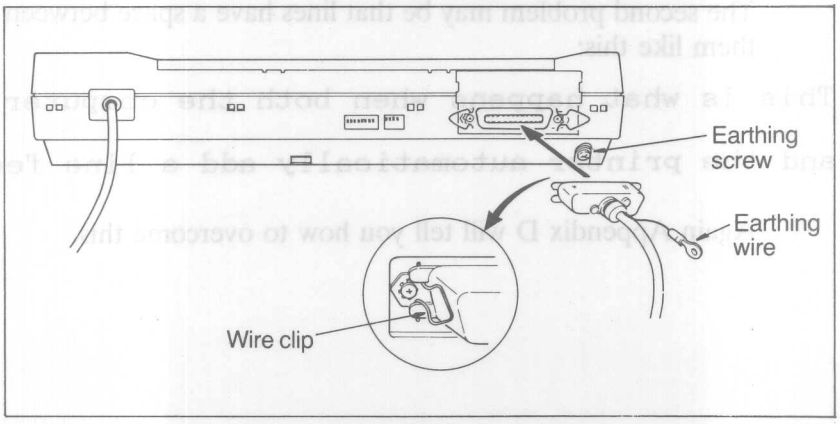


Figure 1-10. Cable connection

Next connect the other end of the printer cable to the computer. On most computers you can easily find the correct connector for the printer cable, but if you are not sure, consult the computer manual or your dealer.

First Printing Exercise

Your next step depends upon what kind of printing you plan to do. If you have a word processing or other commercial software program, load the program into the computer, follow its printing instructions, and the LX-80 will print. If you plan to use the LX-80 for printing program listings, load a program and use the computer system's listing command (LLIST for Microsoft™ BASIC, for example).

Note: The printing may not be correct. One common problem is that all the lines of your text are printed on top of each other, like this:

```
This is what happens when the DIP switch
because
```

Do not worry, there is nothing wrong with the printer. All you have to do is change the setting of a small switch in the back of your printer. See the section on automatic line feeds in Appendix D.

The second problem may be that lines have a space between them like this:

```
This is what happens when both the computer

and the printer automatically add a line feed.
```

Again Appendix D will tell you how to overcome this.

Chapter 2
SelecType

The first chapter displayed some samples of the typestyles available on the LX-80. This chapter shows how Epson's SelecType feature enables you to use the most-used print modes with a few finger-presses on the panel buttons of the LX-80. You can change the printing from

```
standard single-strike pica
```

to the more detailed

```
Near Letter Quality (NLQ) mode
```

or any of several other possibilities.

Choosing Print Modes

The LX-80 printer's many print modes give you a wide choice of width, weight, and style of characters. You can activate these modes in several different ways, depending on your needs and the capabilities of your software. The most common ways include placing printing codes in your document, using a programming language such as BASIC, and giving print commands as part of the printing instructions for your software.

However, these methods are not always convenient and software does not always allow you to make the changes you want to obtain the full facilities. The SelecType feature overcomes such problems and is the easiest way to choose print modes on the LX-80. This feature changes the function of the three buttons on top of the printer–ON LINE, FF, and LF. After turning on the SelecType mode, you can use the buttons to choose one or more of six separate functions. The functions include five typestyles and a reset code.

Table 2-1 shows the total number of typestyles you can set with SelecType, some of them as combinations.

Table 2-1. The various typestyles possible with SelecType

ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi

SelecType lets you use the Epson typestyles in Table 2-1 and combinations of those styles even if the word processing or business program does not support all of them. SelecType also lets you make print style choices when you print rather than when you edit. If you would like a memo or letter to be in the NLQ mode, a few taps on the panel buttons tell the printer what you want, and you don't have to re-edit the document to put in print instructions.

SelecType is also handy for selecting narrow pitches to put more characters onto a line. If you find, for instance, that your spreadsheet would be too wide for a single page in pica, with SelecType you can choose condensed to fit over 130 characters on a line or condensed elite for over 150 characters.

Using SelecType is a simple four-step process:

1) Enter SelecType mode.
2) Select a print function.
3) Set the function.
4) Exit SelecType mode.

Turning SelecType Mode On

To turn on SelecType make sure that the printer is turned on (with the POWER, READY, and ON LINE lights all on), and then press the top two buttons on the panel (ON LINE and FF) at the same time, as illustrated in Figure 2-1. The LX-80 will beep to signal that it is in SelecType mode. The READY light also goes out, and the ON LINE light begins flashing. Note that when the printer is in SelecType mode, all the panel buttons have new functions (also shown in Figure 2-1).

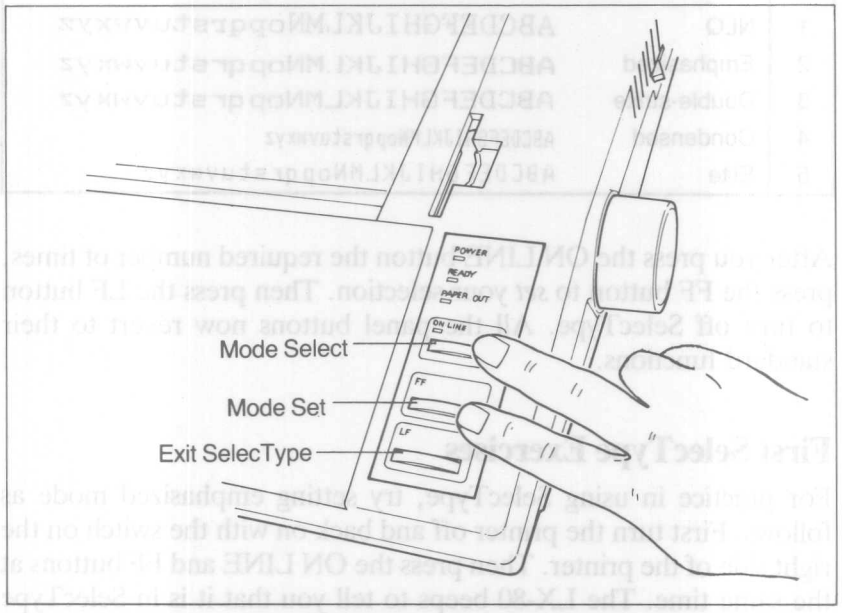


Figure 2-1. SelecType setting and functions

In SelecType mode, the ON LINE button *selects* printing functions, the FF button *sets* the functions, and the LF button turns SelecType off, returning the panel buttons to their former operation.

Using SelecType

Once you have turned on SelecType, you *select* the print functions you want according to Table 2-2. The mode number indicates the number of times you press the ON LINE button to select each function.

Table 2-2. SelecType modes

Mode	Function	
0	Reset	ABCDEFGHIJKLMNopqrstuvwxyz
1	NLQ	ABCDEFGHIJKLMNopqrstuvwxyz
2	Emphasized	ABCDEFGHIJKLMNopqrstuvwxyz
3	Double-strike	ABCDEFGHIJKLMNopqrstuvwxyz
4	Condensed	ABCDEFGHIJKLMNopqrstuvwxyz
5	Elite	ABCDEFGHIJKLMNopqrstuvwxyz

After you press the ON LINE button the required number of times, press the FF button to *set* your selection. Then press the LF button to turn off SelecType. All the panel buttons now revert to their standard functions.

First SelecType Exercises

For practice in using SelecType, try setting emphasized mode as follows. First turn the printer off and back on with the switch on the right side of the printer. Then press the ON LINE and FF buttons at the same time. The LX-80 beeps to tell you that it is in SelecType mode, the READY light goes out, and the ON LINE light begins blinking. Then press the ON LINE button twice to *select* emphasized. (The printer beeps each time that you press the ON LINE button in SelecType mode.) After that, press the FF button once to *set* the function.

You have now set emphasized mode. Next, press the LF button once, and the panel buttons return to their normal operation. Since this is only an exercise, turn the LX-80 power switch off and back on again to cancel all settings and prepare for the next exercise.

You will probably use SelecType with commercial software as well as with BASIC or another programming language. It may be more convenient to try this exercise with BASIC. You don't need to know

anything about programming for this exercise. It is merely for practice. If your computer system does not include BASIC or if you would rather not use it, use another means of printing some text from your computer such as using a short word processor file.

To use BASIC, type the short BASIC program listed below:

```
10 LPRINT "This is a sample program."
20 LPRINT "Notice the size ";
30 LPRINT "and darkness of the print."
```

Next, print a listing of the program using LLIST or the computer system's print listing command. The LX-80 prints the program in ordinary single-strike pica, as illustrated below in our sample program.

```
10 LPRINT "This is a sample program."
20 LPRINT "Notice the size ";
30 LPRINT "and darkness of the print."
```

If you are using another means of printing the text print it out that way now.

Now that you have a sample program to list or some text to print out, follow these simple steps to print it in condensed mode:

1) See that both the ON LINE and READY lights are on.
2) Press the ON LINE and FF buttons at the same time. The LX-80 will beep to signal that SelecType is on.
3) As you can see in Table 2-2, the code for condensed is four. Therefore, press the ON LINE button four times. (Remember that you hear a beep each time you press the ON LINE button when you are in SelecType mode.)
4) Now that you have *selected* condensed, press the FF button once to *set* that mode.
5) Press the LF button once to return the panel buttons to their standard functions.

Now the LX-80 has been set to print in condensed mode, press the ON LINE button to put the printer back on line and list the program once more. It should print in condensed mode just as in the example below:

```
10 LPRINT "This is a sample program."
20 LPRINT "Notice the size ";
30 LPRINT "and darkness of the print."
```

Try this exercise with other modes. The easiest way to reset the modes at this stage is to switch the printer off and on again. It is possible to reset it using SelecType, as described in Appendix F.

Testing Your Software for the Reset Code

Some commercial software programs clear all previous modes by resetting the LX-80 before printing each document. Of course, this resetting wipes out whatever you have done with SelecType. But don't worry if your software resets the printer; you can still use SelecType. Appendix F suggests ways of overcoming the problem.

The following test tells you whether your program resets the LX-80 before printing. First, use the word processing or business program in the normal way to create a short file or document.

Print it in the usual way. Save this first copy for comparison with the next versions you print. Your test can be as simple as our example below, a two-line document created with a word processor and printed with its standard print command.

```
This is a short document, but it is long
enough to check for a resetting code.
```

Now set the LX-80 for elite printing using the following steps.

1) See that both the ON LINE and READY lights are on.
2) Press the ON LINE and FF buttons at the same time.
3) Depress the ON LINE button five times (the code for elite). You should hear a beep each time you press the button.
4) Press the FF button to set elite.
5) Press the LF button to leave SelecType and return the panel buttons to their standard functions.

Now press the ON LINE button and print the file again, using exactly the same command that you used before. If your document comes out in elite as in our example below, you can forget about resetting codes and continue to use SelecType as described above.

```
This is a short document, but it is long
enough to check for a resetting code.
```

However, if the example is once again printed in pica, turn the printer off and back on. Then try the steps above one more time to be sure that you did not make any mistakes. If your printout is still in pica after the second test, turn to Appendix F for an explanation of how to solve the problem.

Mode Combinations

In addition to the five nominal typestyles available with SelecType, you can also use many more by combinations of the five. An X in a box in Table 2-3 shows that the two modes can be combined.

Table 2-3. Mode combinations

Mode	NLQ	Emphasized	Double-strike	Condensed	Elite
NLQ		×			
Emphasized	×		×		
Double-strike		×		×	×
Condensed			×		×
Elite			×	×	

To combine modes you simply *select* and *set* more than one mode before you press the LF button to leave SelecType. After beginning in the normal way and pressing the ON LINE button to select a function and the FF button to set it, do not press the LF button. Instead, press the ON LINE button the required number of times to select another mode and set that mode with the FF button. When you have selected and set all the modes you want, press the LF button to leave SelecType.

You cannot damage the printer by trying to combine two modes that the LX-80 cannot mix, because it intercepts conflicting codes and uses only one.

When combining modes you have to keep count of the number of times you need to press the ON LINE button. When you reach the number of presses for the first mode, you press the FF button to set that mode and then carry on, continuing the count. For example suppose you wish to combine double strike and elite modes. If you were setting them separately, you would press 3 times for double strike and 5 times for elite. In the combination, you have to press the ON LINE 3 times for double strike, then press the FF button to set it, then press ON LINE twice to set elite. This means a total of 5 presses. Pressing FF sets elite and hence the combination. The number of times you press the ON LINE button adds up to the mode which is set when you press the FF button.

At the end of the chapter is a summary chart which shows the possible ways of setting the combinations. Practice different settings. Another detailed example is outlined step by step below. If you follow these steps you will combine NLQ with emphasized for a crisp, bold effect:

1) See that the ON LINE and READY lights are on. Then press the ON LINE and FF buttons at the same time.

2) Press the ON LINE button once and then the FF button once. Since one is the code for NLQ, you have now set the LX-80 for that mode.

3) Press the ON LINE button one more time and then the FF button once. This makes a total of twice, and thus sets the LX-80 for emphasized also.

4) Press the LF button to return the panel buttons to their standard functions.

Now press the ON LINE button and print the document. If the printing appears in

emphasized Near Letter Quality

as you see here, you have successfully combined the two modes. If you obtain any other results, turn the printer off and back on (to reset it) and then try the steps again.

SelecType Cautions and Tips

Once you have learned the simple technique for controlling print styles with the panel buttons, you can use it whenever you wish. You should be aware of two minor restrictions, however.

- SelecType is designed to control the printing of an entire file or document, not an individual line or word. To print a single word in an enhanced mode, you will have to place a printing code in your document, giving a print command as part of the software's print option or use the commands in a programming language such as BASIC.

- If there are print codes in the document or file you are printing, those codes override your SelecType settings. This is unlikely to happen, since you would normally use SelecType on files that do not contain print codes but which you wish to print out totally in one mode. Remember that if the LX-80 follows the SelecType instructions for only part of a document, you may have print codes in the document that are conflicting with the SelecType modes.

Remember that any mode you turn on with SelecType stays in effect until the printer is turned off or receives a cancelling or reset code. Turning off the printer is the simplest method of cancelling the modes you have set, but if you want to learn how to cancel them by using SelecType, turn to the section called Cancelling Functions with SelecType in Appendix F.

Summary of the steps in using SelecType

1.	Enter SelecType	Press LF and ON LINE together
2.	Select mode	Press ON LINE the required number of times
3.	Set the function	Press FF button
4.	Exit SelecType	Press LF button
5.	Set LX-80 ON LINE	Press ON LINE

SelecType Setting Sequences

This chart shows the sequences used to obtain the 12 typestyles and combinations available using SelecType. Simply press the On Line (OL), Line Feed (LF) and Form Feed (FF) buttons on the LX-80 control panel following the sequence and number of times indicated.

Table 2-4. SelecType sequence for setting typestyles

OL/LF	OL	FF	OL	FF	OL	FF	LF	OL	
1--	0	1	----------				1	1	Draft pica
	1	1	----------				1	1	Near Letter Quality
	2	1	----------				1	1	Emphasized
	3	1	----------				1	1	Double-strike
	4	1	----------				1	1	Condensed
	5	1	----------				1	1	Elite
	1	1	1	1	----------		1	1	NLQ/emphasized
	2	1	1	1	----------		1	1	Emphasized/double-strike
	3	1	1	1	----------		1	1	Double-strike/condensed
	3	1	2	1	----------		1	1	Double-strike/elite
	3	1	1	1	1	1	1	1	Double-strike/condensed/elite
	4	1	1	1			1	1	Condensed/elite

Combinations other than those given above are overwritten by the last mode selected.

Chapter 3
Elements of Dot Matrix Printing

This chapter is for those who want to go into how the printer works. It is a simple, non-technical explanation of the basics of dot matrix printing which will give you a better understanding of some of the later chapters.

The Print Head

The LX-80 uses a print head with nine pins or wires mounted vertically. These pins make the dots by being pushed out of their resting position. Since this is analogous to shooting with a gun, it is known as making the pin "fire". Each time a pin is fired, it strikes the inked ribbon and presses it against the paper to produce a dot. This dot is about 1/72nd of an inch in diameter. The size varies slightly depending upon the age of the ribbon and the type of paper used. As the head moves horizontally across the page, these pins are fired time after time in different patterns to produce letters, numbers, symbols, or graphics.

For example, to print a pica capital T, the head fires the top pin, moves 1/60th of an inch, fires the top pin again, moves 1/60th of an inch, fires the top seven pins, moves 1/60th of an inch, fires the top pin, moves another 1/60th of an inch, and fires the top pin once more to finish the letter. All this happens in only 1/100th of a second.

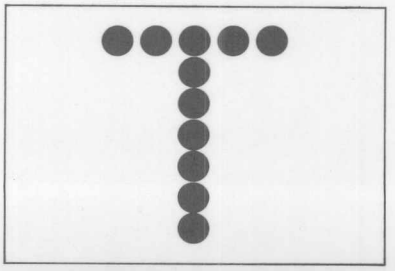


Figure 3-1. A capital T

Bidirectional Printing

Nearly all discussions in this manual describe the action of the LX-80 print head as moving from left to right. However, during its normal operation while printing in the draft mode, the LX-80 prints bidirectionally. This means that the print head first goes from left to right, and instead of coming back to the beginning of the next line, it saves time by printing the next line of characters in reverse from right to left. This is done automatically. You do not know it is happening unless you watch it.

Changing Pitches

In addition to pica, in which there are 10 characters per inch, the LX-80 can also print in other widths, or pitches. It does so by reducing the distance between pin firings. In the elite mode it prints 12 characters per inch and in the condensed mode it prints slightly more than 17 characters per inch. The pattern of the dots is not changed, but the horizontal space between them is reduced.

Figure 3-2 shows enlargements of four sample letters in each of the three pitches. These letters are chosen to show how the LX-80 prints letters that are uppercase (capital letters) and lowercase ("small letters"), wide and narrow, and with and without descenders (i.e., the bottom part of a letter such as y or g which descends below the base-line of most characters).

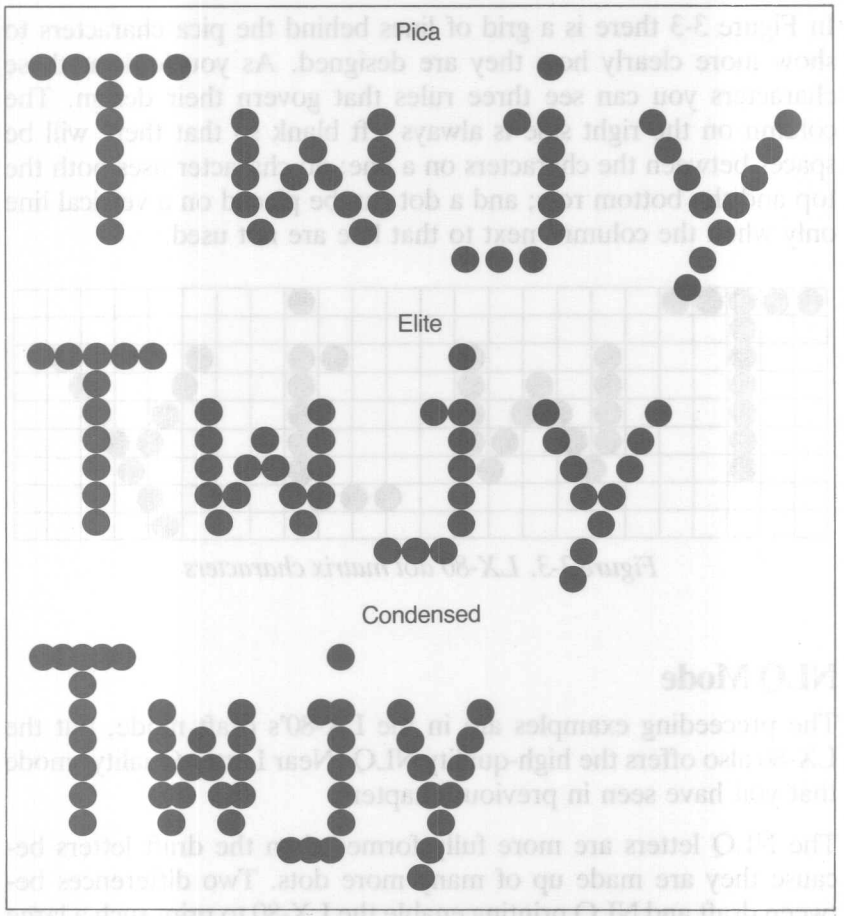


Figure 3-2. The three pitches of the LX-80

The dot pattern of each character is carefully designed so that in pica mode no dot overlaps another; in normal high-speed printing of pica the pins cannot fire and retract and fire again quickly enough to print one dot overlapping another.

In Figure 3-3 there is a grid of lines behind the pica characters to show more clearly how they are designed. As you look at these characters you can see three rules that govern their design. The column on the right side is always left blank so that there will be spaces between the characters on a line; no character uses both the top and the bottom row; and a dot can be placed on a vertical line only when the columns next to that line are not used.

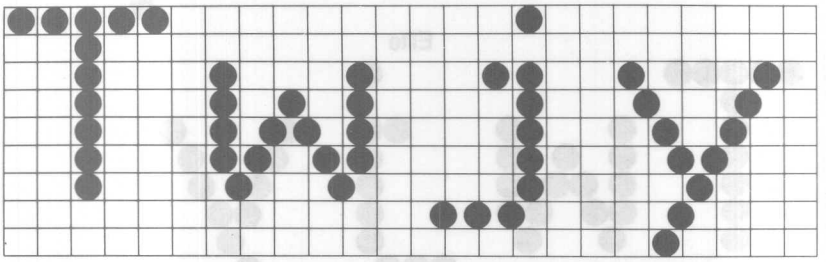


Figure 3-3. LX-80 dot matrix characters

NLQ Mode

The preceeding examples are in the LX-80's draft mode, but the LX-80 also offers the high-quality NLQ (Near Letter Quality) mode that you have seen in previous chapters.

The NLQ letters are more fully formed than the draft letters because they are made up of many more dots. Two differences between draft and NLQ printing enable the LX-80 to print such a large number of dots for each character. In the NLQ mode, the head moves more slowly, so that dots can overlap horizontally, and each character is printed by the head moving back to the beginning of the line and printing more dots on top of the first ones. This is known as a double pass.

To further ensure the quality of NLQ characters, both passes of the print head are in the same direction so that the alignment of the dots is exact.

Because the NLQ mode uses two passes for each line and prints only in one direction, printing does take longer in this mode.

With the two modes, draft or NLQ, the LX-80 gives you the ability to choose high speed or high quality respectively each time you print. You can print ordinary work or preliminary drafts quickly in the draft mode and use the NLQ mode for final copies or special purposes.

SelecType makes it especially easy to change from draft to NLQ, but you can also select and cancel the NLQ mode with a software command or with a special switch in the back of the printer. Use of the software command is explained in Chapter 5 and the operation of the switch (called a DIP switch) in Appendix D.

Chapter 4
Printer Control Codes

The LX-80 printer is easy to use, especially with commercial software which has print control features. This chapter explains some of the basics of printer control and helps you understand how a computer communicates with the printer. This information should also enable you to understand the terms used in the software or computer manual.

If you are an advanced user or a programmer, you may want to turn to Appendix B, where there is a full summary of all the LX-80 commands.

ASCII Codes

When you type in a document using a word processing program, you press keys with letters or numbers on them and when you send the document to a printer, it prints the corresponding letters and numbers onto the paper. The computer and the printer, however, do not use or understand letters of the alphabet. They function by manipulating *numbers*. Therefore, when you press the **A** key, for example, the computer sends a number to its memory. When the computer tells the printer to print that letter, it sends the number to the printer, which must then convert the number to a pattern of pins that will fire to print the dots that make up that letter.

The numbers that computers and printers use are in binary form, which means that they use only the digits 0 and 1. In this manual, however, we use decimal numbers in our explanations because most users are more familiar with these numbers and because most programming languages and applications programs can use decimal numbers. The computer system or the program takes care of changing the decimal numbers to binary form.

Computer and printer interaction would be terribly confusing if different kinds of computers and printers used different numbers for the same letter of the alphabet. Therefore, most manufacturers of computers, printers, and software use the American Standard Code for Information Interchange, usually referred to as ASCII (pronounced ASK-Key). The ASCII standard covers the decimal numbers from 0 to 127 and includes codes for printable characters (letters, punctuation, numerals, and mathematical symbols) and a few control codes, such as the codes for sounding the bell and performing a carriage return.

Although other codes are not standardized in the computer industry, the ASCII system means that at least the alphabet is standardized. A programmer or engineer knows, for example, that 72 is the decimal code for a capital **H** and 115 is the code for a lower case **s** no matter what system he or she is using.

ESCape Codes

Although the original ASCII standard was designed to use the decimal numbers 0 through 127, computer and printer manufacturers soon extended this range (to 0 through 255) in order to make room for more features. On the LX-80, for example, the codes from 160 through 254 are used for italic characters. Because even this extended is not enough for all the features used on modern printers, the range is further extended with a special code called the Escape code. This code is often printed with the first three letters capitalized (ESCape) or abbreviated as ESC or <ESC>.

When the <ESC> code, which has the decimal value 27, is used, printers and computers are not restricted to only 256 instructions. The <ESC> code is a signal that the next code will be a printer control code instead of text to print. For example, if the printer receives the number 69, it prints a capital **E** because 69 is the ASCII code for that letter. If, however, the printer receives code 27 just before the 69, it turns on emphasized mode, because <ESC> E is the code sequence for emphasized.

You can see how important the <ESC> code is by looking at Appendices A, B and C. You will see that nearly every code the LX-80 uses is an <ESC> code.

Printer Codes

To take advantage of the many print features of the LX-80, you can use a software program that sends the correct codes or you can use another method to send instructions to the printer. It is not possible to be as precise and specific as we would like in this chapter because the LX-80 works in combination with so many different applications programs and computer systems.

However, this chapter will lay down the general principles of how software communicates with the printer, plus several ways in which the codes of the LX-80 are used by word processing and business programs. With this information and possibly some help from your dealer or the operating manual for the applications program, full advantage can be taken of all the features of the LX-80 that you wish to use. Incidentally, there is no standard terminology for software codes; thus, the terms in the software manual may differ from the ones used here.

There are a number of ways of sending printer codes with commercial software:

- Using SelecType, as described in Chapter 2.
- Instructing the program during an installation or setup procedure enabling you to use special codes that are typed in along with your text or data. These will be referred to as "software command" codes.
- Inserting LX-80 printer codes in the text enclosed by special instruction characters which tell the printer that the "embedded" codes are not text or data, but special codes for the printer.

There are three common formats for inputting printer codes either into the program or inserting them into the text. The applications software or its manual should tell you which one to use.

- Decimal numbers — 27, for example is the decimal number for the <ESC> code, and 13 is the decimal number for a carriage return.
- Hexadecimal numbers (sometimes abbreviated to hex), for example in which the <ESC> code is 1B and a carriage return is 0D. You do not have to understand hexadecimal numbers to use them. If your software calls for hex numbers, just consult Appendix C or the Quick Reference Card for the appropriate number.

- Entering the code directly from the keyboard by pressing special combinations of keys. It is normally possible to use a special key called the control key which is usually marked CTRL or CONTROL, in conjunction with the remaining keys. The <ESC> code can frequently be obtained by pressing a key marked ESC or ESCAPE. However, in some cases the computer returns a different character because it is intended to escape from a particular situation. A table showing which keys to press for each code is given in Appendix A. For example, a carriage return can be obtained by pressing the control key and the M key at the same time.

Software command codes

A program that uses software command codes has its own set of codes that you type into the document or file. When the program receives one of these codes, it sends the proper code to the LX-80. For example, in one popular word processing program you can cause a block of text to be printed in italic mode by pressing the control key together with the P key at the start of the text. Pressing the control key together with the Q key at the end of the block of text returns you to normal printing. You can see these on the screen as ^P and ^Q. They are not printed as such, but when the ^P (control P) is reached in the text being sent to the printer, the program sends the correct code to turn the italic mode on. When the ^Q (control Q) is reached, the code to switch italic mode is sent. It does not send the ^P or ^Q, which are merely markers in the text telling the word processor program what to do. The program finds the codes from a table which either the manufacturer of the software provides or you can make yourself. Please note that these codes are part of the word processor program and do not have the same function as the control key codes mentioned above which are the ones the printer itself understands.

In order for the table of codes to be correct for your particular printer, you have to run a setup or install program when you first use the package. Often the program simply asks you the type of printer you have. Once you tell such a program that you are using an Epson printer, it will know which codes to send. (Often you do not need to specify which Epson printer you are using.) In some cases the table is built up as answers to a series of questions. The answers to the sequences are given in Appendix C. The instructions should be in the software manual. In addition, your software or computer dealer may be able to help you.

Inserting codes directly into the text

Some software packages are more versatile in that they allow you to enter any set of codes you like, embedding them between a pair of markers so that the program knows that they are special and not text or data. This is slightly more difficult since you have to use Appendix C regularly to decide which codes you need. In one such program, for example, typing Control-V (pressing V while holding down the control key) signals the beginning of printer instructions. Then you enter the print codes by pressing various combinations of Control and alphanumeric keys and then type Control-V again to signal the end of the printer instructions.

If the word processing program allows you to insert the actual codes required, you can use SelecType to set the print mode for the whole document. It is only for special features that you will need to use embedded codes. For example, if you want to have headings in wide bold printing (called enlarged emphasized), you would probably have to use embedded codes. For the program we mentioned above you would type Control-V, then the code for enlarged emphasized. If the enlarged is to be switched off after one line, ASCII 14 is the code required. The emphasized code sequence is <ESC> E. Thus the codes to go into the word processor would be Control-N to give the ASCII 14, followed by <ESC> and then an upper case letter E. Finally the embedded text marker is given with a Control-V again, and then the text of the heading. Further information on the codes is given in Appendices A, B and C.

Again, if this sounds too complicated, don't worry. Use the LX-80 with the standard features of the word processing program until you become more familiar with both of them. Then you can decide whether or not you need or want to learn to use embedded codes.

Programming Languages

If neither of the methods described above seems appropriate for your application, you can write a program in BASIC or any other programming language to send control codes to the printer before you run your applications program. In the chapter on page formatting you will find examples of such programs. Just remember that with this method the printer control code stays in effect for the whole document you print. This method works for a wide range of commands and is good for setting margins, for example, but does not work for italicizing a word. It has the same drawback as SelecType in this context and is only of use for whole documents.

Now you have some background on how printers work and how software can communicate with them. Turn to the next chapters to learn about the specific features of the LX-80 printer.

Chapter 5
LX-80 Features

This chapter and later chapters describe some of the printing features of the LX-80 and although it includes programs that demonstrate these features, you do not have to be a programmer to use them.

Demonstration Programs

The description and examples of the LX-80 features are accompanied by demonstrations in the BASIC programming language which enable you to see these features in action. Although you may not do much of your printing using BASIC, it was chosen for the demonstrations because most computer systems include some form of BASIC, and the examples are ones that almost every one of you can try out.

You only need to know a little about BASIC to type in and run these programs. Running the programs, reading the explanations and looking at the printed examples, show you how the LX-80 responds to the messages the computer sends it by printing letters, numbers, symbols, and graphics in various print modes.

Even if you never use BASIC again, you will know the capabilities of the printer, capabilities that can often solve your printing problems. For example, if you need a special symbol, such as the Greek character Σ, you will know that you can turn to the chapter on user-defined characters and create such a character.

The exercises in BASIC are not absolutely essential. Many users are quite happy with their printers without ever learning any more about them than how to turn them on and off and how to load paper. In most cases the software that you use for word processing, business, or graphics does the calculating and communicating with the printer for you.

In fact, because of Epson's long-standing popularity, many programs are designed to use Epson printers as standard. Often all that you need to do is specify in an installation program that you are using an Epson printer. Then the program sends the correct codes for the various printing functions. The installation process, if there is one, is explained in the manual for your software program.

The examples in this manual are in Microsoft BASIC (MBASIC), the most widely used BASIC in personal computers, and most users can enter and run the programs exactly as they appear in these pages.

If your computer system uses any other kind of BASIC, you may have to make a few changes. Probably the only item you will need to change is the instruction LPRINT, which is the MBASIC command to send something to the printer. Applesoft BASIC, for instance, uses PR#1 at the beginning of a program to route information to the printer and PR#0 at the end to restore the flow of information to the screen. BBC BASIC starts sending information to the printer with the VDU2 command and stops with VDU3. In both cases all output to the screen made by PRINT statements also goes to the printer. If you have such a system, use the command to turn the printer on and then use PRINT instead of LPRINT in the programs. If you have any other system, consult its manual to see if any modifications to the programs in this manual are necessary. Specific problems with your computer may also be outlined in Appendix F.

In Chapter 3, Figure 3-2 showed the enlargements of the three LX-80 pitches. Chapter 2 showed how to choose them with SelecType. The rest of this chapter is concerned with changing the pitch and setting NLQ characters under software control.

Pica Printing

The first exercise is a simple three-line program to print a sample line of characters in pica, the standard pitch. Just type in this program exactly as you see it:

```
40 FOR X=65 TO 105
50 LPRINT CHR$(X);
60 NEXT X: LPRINT
```

Now run the program. You should get the results you see below, 10 pica characters per inch.

```
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
```

Other Pitches

As explained in Chapter 3, the LX-80 uses the same pattern of dots for pica, elite, and condensed characters, but it changes the horizontal spaces between the dots to produce the three different widths.

In elite mode there are 12 characters per inch, and in condensed there are 17.16. The LX-80 prints in elite when it receives the <ESC> M command and prints in condensed when it receives the ASCII 15 command. Print a sample line of elite characters by adding this line to your previous program:

```
2Ø LPRINT CHR$(27)"M";
```

This line uses the command <ESC> M, to turn on elite mode. Your printout should look like this:.

```
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
```

Now add a line to the program to cancel elite with <ESC> P and turn on condensed with ASCII 15:

```
3Ø LPRINT CHR$(27)"P"CHR$(15);
```

Run the program to see the line printed in condensed mode.

```
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
```

Cancelling Codes

As you saw in the third version of the print pitch program, you must cancel a code when you do not want it any more. With very few exceptions, the LX-80 modes stay on until they are cancelled. It is important to remember this because an LX-80 mode can stay on even if you change from BASIC to another type of software. For example, if you print a memo with a word processing program after you run the program above, the printer will still be in condensed mode, and so the memo will be in condensed print. To cancel condensed mode, use ASCII 18.

To avoid having one program interfere with the printing modes of another, you can cancel a mode in one of two ways:

- Using a specific cancelling code to just cancel one mode. The <ESC> P in the last line of the program in the previous section was used to cancel elite. Each mode has a cancelling code, which you can find in the discussion of the code and in Appendix B. Pica is an exception to this rule. To cancel pica, turn on elite or condensed.
- Resetting the printer, a method explained in the next section.

Resetting the Printer

Resetting the LX-80 cancels all modes that are turned on. You can reset the printer with one of two methods:

- Sending the reset code (<ESC> "@")
- Turning the printer off and back on.

Each of these methods returns the printer to what are called its defaults, which are the standard settings that are in effect every time you turn the printer on. The two effects of resetting the printer that you should be concerned with are: it returns the printing to single-strike pica (unless you have set the DIP switch on the back of the printer to make the default NLQ or condensed mode), thus cancelling any other pitches or enhancements you may have turned on, and the current position of the print head becomes the top of page setting.

It is also possible to use SelecType to return to single-strike pica without resetting any other codes to their defaults. Some of the demonstration programs end with a reset code so that the commands from one program will not interfere with the commands in the next one. After you run a program with a reset code in it, remember to change the top of page setting before you begin printing full pages.

Pitch Comparison

Now that you have used three short programs to produce samples of the three main pitches, you can choose the pitch that you prefer or the one that best fits a particular printing job. Most people use either pica or elite for printing text and condensed for spreadsheets or other applications where it is important to get the maximum number of characters on a line.

In fact, if you need even more than the 132 characters per line that condensed gives you, you can combine elite and condensed for a mode. It is not really another pitch, because the size of the characters is the same as in the condensed mode; only the *space between* the characters is reduced. You can see this mode, which allows 160 characters to fit on a line, if you replace line 30 in your last program with this line:

```
3Ø LPRINT CHR$(15);
```

With this addition, the program turns on condensed but doesn't turn off elite, giving you the printout below:

```
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
```

If your printout is different, you may need a WIDTH statement. This is described further in Appendix F. The format for your system may be different. Consult your BASIC manual. It will probably take the form:

```
5 WIDTH LPRINT 255
```

As a comparison, the output for straight condensed is:

```
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
```

Near Letter Quality Mode

The examples so far in this chapter are in the draft mode, and you have already learned how to turn on the NLQ mode with SelecType, but you can also see the NLQ mode with the following program:

```
1Ø LPRINT CHR$(27)"x"CHR$(1);
2Ø FOR X=65 TO 1Ø5
3Ø LPRINT CHR$(X);
4Ø NEXT X: LPRINT
```

Note that you use a lower case x, not a capital X, in line 10. Because of the high resolution of the NLQ mode, it prints only in pica, not in elite or condensed.

All the modes demonstrated in this chapter are compared in Table 5-1.

Table 5-1. Summary of LX-80 pitches

Print sample ← 1 inch →	CPI	Codes	
		On	Off
Near Letter Quality	10.00	ESC "x" 1	ESC "x" 0
Pica print	10.00		
Elite print	12.00	ESC "M"	ESC "P"
Condensed print	17.16	15	18
Condensed elite print	20.00	ESC "M" 15	ESC "P" 18

Remember that you do not have to use BASIC to change modes; you can use any method that sends the printer the proper codes.

You may wish to have NLQ as the default mode when you switch on. This can be changed by altering a DIP switch on the back of the LX-80. See Appendix D for details of how to do this.

Chapter 6
Print Enhancements and Special Characters

The LX-80 cannot only change the pitch — it has many more ways of varying and enhancing printing. To avoid your having to type in dozens of programs to try all the features, this chapter gives you just one master program that can demonstrate any feature.

Bold Modes

Besides the pitches (pica, elite, and condensed) covered in Chapter 5, the LX-80 offers many other typestyles, including two for bold printing—emphasized and double-strike.

Emphasized mode

In the emphasized mode the LX-80 prints each dot twice, with the second dot slightly to the right of the first. In order to do this, the print head must slow down so that it has time to fire, retract, and fire the pins quickly enough to produce the overlapping dots. As you can see in Figure 6-1, this method produces better-looking, more fully-formed characters that are darker than single-strike ones.

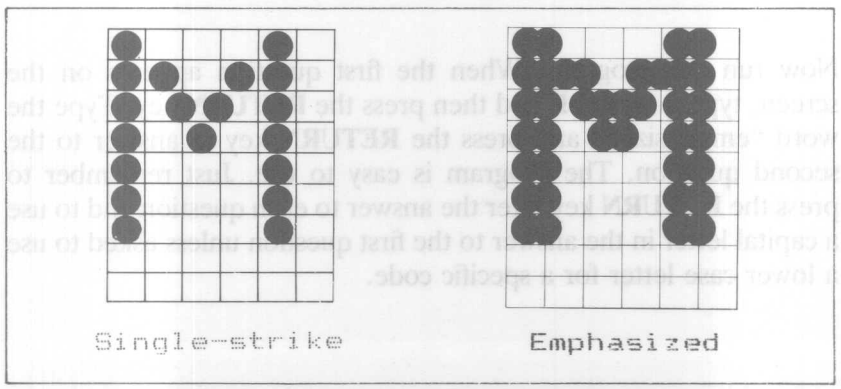


Figure 6-1. Single-strike and emphasized

Emphasized works only in draft pica and NLQ modes. In elite and condensed the dots are already so close together that even with the reduced print speed, the LX-80 cannot fire, retract, and again fire the pins quickly enough to print overlapping dots.

You do sacrifice some print speed and ribbon life with emphasized, because the print head slows down and prints twice as many dots, but the increase in print quality is well worth it. Indeed, you may want to use emphasized instead of the NLQ mode for some purposes because emphasized printing is faster than NLQ printing.

The following master program allows you to test almost any of the <ESC> codes, including the <ESC> code to turn on emphasized: <ESC> E.

Master program

First, type in the program below. If you have some programming experience, you can see that it asks you what codes you want to test and then prints a sample of printing after the code has been given so that you can see what the codes do. Ensure that you have typed the blank spaces in lines 70 and 80. If you are using a BASIC which does not have the LPRINT command, go to Appendix F to check how to modify the program.

```
20 PRINT "Which ESCape code do you "
30 INPUT "want to test";A$
40 PRINT "What kind of printing "
50 INPUT "does it produce";B$
60 LPRINT CHR$(27)A$
70 LPRINT "This sample uses ESCape ";A$
80 LPRINT "to produce ";B$;" printing."
90 LPRINT CHR$(27)"@"
```

Now run the program. When the first question appears on the screen, type a capital **E** and then press the **RETURN** key. Type the word "emphasized" and press the **RETURN** key in answer to the second question. The program is easy to use. Just remember to press the **RETURN** key after the answer to each question and to use a capital letter in the answer to the first question unless asked to use a lower case letter for a specific code.

You should get the following printout when you run this program and type the letter E and "emphasized" in answer to the questions.

```
This sample uses ESCape E
to produce emphasized printing.
```

The code to turn off emphasized is <ESC> F.

Double-strike

The other bold mode on the LX-80 is double-strike. For this mode the printer prints each line, then moves the paper up slightly and prints the line again. Each dot is printed twice, with the second one slightly below the first as you can see in Figure 6-2.

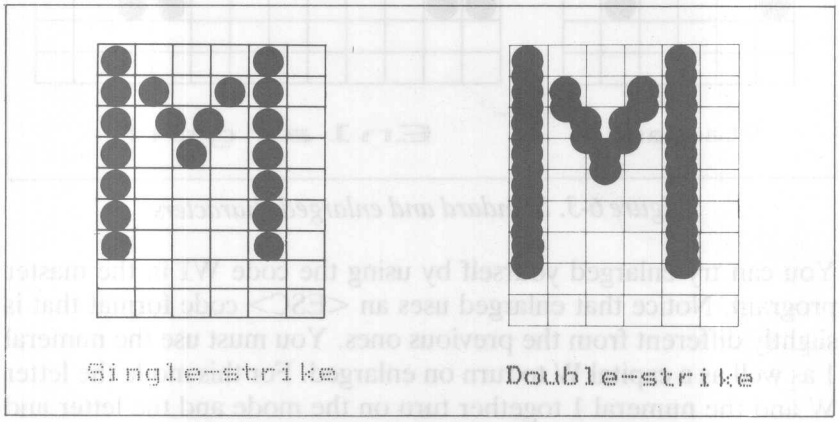


Figure 6-2. Single-strike and double-strike

Unlike emphasized, double-strike combines with any draft pitch (but not with NLQ) because it does not overlap dots horizontally. Since each line in this mode is printed twice, the speed of printing is slowed down. The code for double-strike is <ESC> G. Try it in the the master program if you wish. The code to turn off double- strike is <ESC> H.

Enlarged Mode

Perhaps the most dramatic mode on the LX-80 is enlarged. It produces extra-wide characters that are good for titles and headings. For this mode, the dot pattern of each character is enlarged and a duplicate set of dots is printed one dot to the right. You can see the difference between pica and enlarged pica in Figure 6-3.

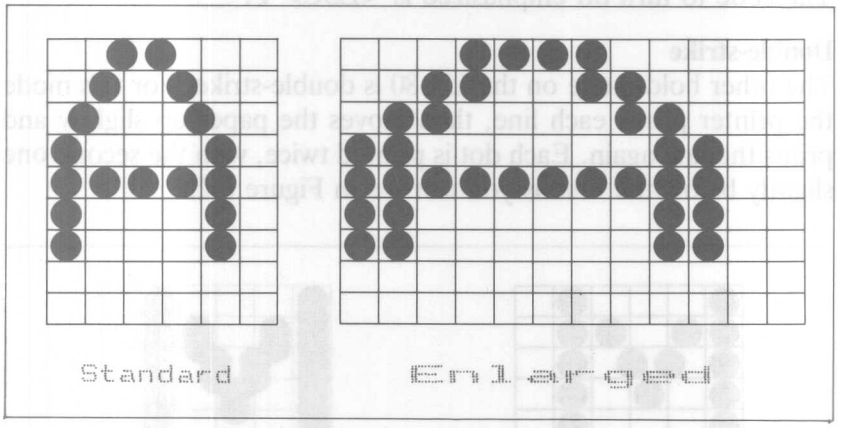


Figure 6-3. Standard and enlarged characters

You can try enlarged yourself by using the code W1 in the master program. Notice that enlarged uses an <ESC> code format that is slightly different from the previous ones. You must use the numeral 1 as well as a capital W to turn on enlarged. For this mode the letter W and the numeral 1 together turn on the mode and the letter and the numeral 0 together turn it off. Thus <ESC> W1 turns on enlarged and <ESC> W0 turns it off.

Those of you who are programmers may be interested in another form of enlarged. In this alternate form, called one-line enlarged, the printing is the same as that in Figure 6-3, but it is turned on by ASCII 14 and is turned off by a line feed, ASCII 20, or <ESC> W0.

Mode Combinations

If you have read Chapter 2, by now you are probably wondering how to combine modes using control codes as you did with the SelecType feature. For example, can a title be made especially vivid by combining enlarged and emphasized? The answer is that you can combine nearly all of the print modes on the LX-80. Indeed, the LX-80 printer can print such complicated combinations as double-strike emphasized enlarged underlined italic subscript, although it

would be hard to imagine why you would ever want to use such a combination. The point is, however, that the LX-80 has the ability to produce almost any combination you can think of. It is up to you to decide which ones you want to use.

To see a few combinations, remove line 90 from the master program. (In MBASIC simply type 90 and press **RETURN** to delete the line.) Now run the program once and enter the letter E and the word emphasized in response to the questions on the screen. This will give you the same results as the first time you ran the program, but it will leave the printer in emphasized mode so that you can add another mode. Then run the program again (without turning off the printer). The second time enter the response W1 and the words emphasized enlarged to the two questions.

Your printout should be in the typestyle below, showing that the two modes combine with no trouble. You can experiment with other combinations if you wish or you can wait for the section later in this chapter that explains a special <ESC> code, Master Select, which allows you to combine as many as seven features with one <ESC> code.

```
Emphasized enlarged
```

When you have finished trying combinations, be sure to replace line 90 in the master program so that you can again try one feature at a time.

Italic Mode

You may occasionally want to print italic words for emphasis, titles, or other uses. The LX-80 has another pair of sequences to allow you to switch italic mode on and off. Although characters produced by the previous modes in this manual are modifications of the standard pica characters, the LX-80 uses completely different characters for the italic mode. You can see the difference between standard and italic draft characters in Figure 6-4.

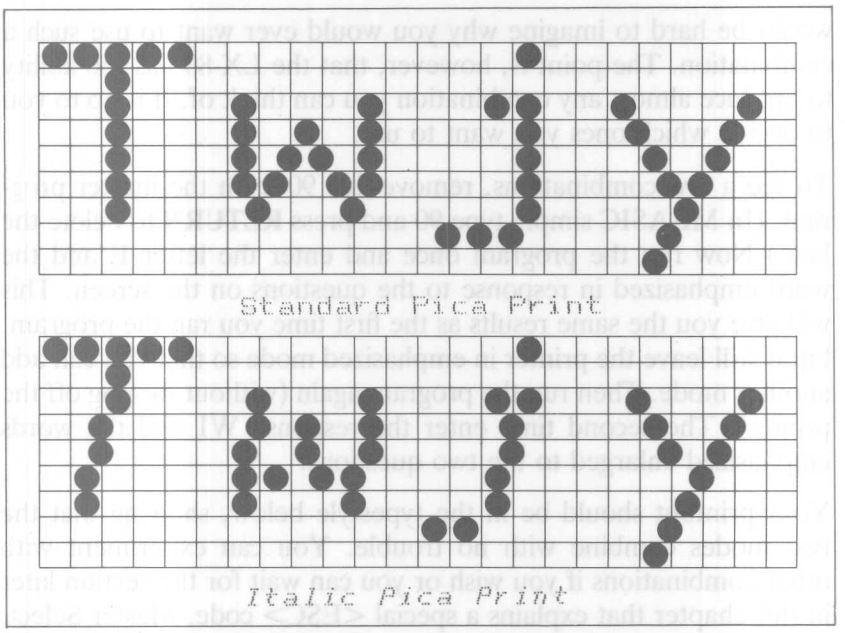


Figure 6-4. Pica and italic print

The code to turn italic mode on is <ESC> 4. Try it in the master program if you wish. When you use this code in the master program, enter 4 in answer to the first question just as if it were a letter of the alphabet instead of a number. <ESC> 5 turns off italic mode.

Those of you who use this code in an applications program should remember that any number used in discussions of <ESC> codes is an alphanumeric character, not a numerical value.

Underline Mode

The LX-80 also has a mode that will underline characters and spaces. You turn it on with <ESC> −1 and off with <ESC> −0. Note that the underline code is like the enlarged code in that it uses a character, in this case the hyphen or minus sign, combined with the numerical character 1 to turn it on and a character combined with the numerical character 0 to turn it off. As you can see in Figure 6-5, this mode prints a dot in the bottom row of each column, thus producing a continuous underline.

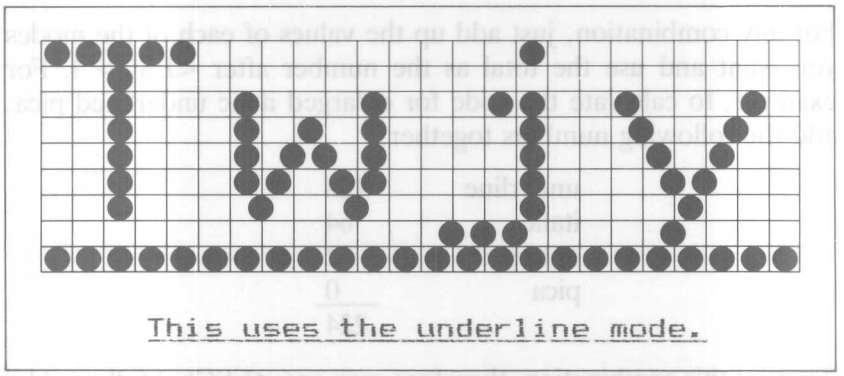


Figure 6-5. The underline mode

As shown in Figure 6-5, the underline mode is continuous, but some word processing and other applications programs produce an underline that leaves spaces between characters as demonstrated in the printout below.

```
This uses the underline character.
```

If the software prints this type of underline, it is using the LX-80's underline character (ASCII 95), not the underline mode. Because the underline character is only five dots wide, it does not fill the spaces between characters. If you prefer a continuous underline, you may be able to use the underline mode through one of the methods we discussed in Chapter 4.

Master Select

The LX-80 has a special <ESC> code called Master Select that allows you to choose any possible combination of eight different modes: pica, elite, condensed, emphasized, double-strike, enlarged, italic, and underline. The format of the Master Select code is <ESC> ! followed by a number that is calculated by adding together the values of the modes listed below:

underline	128
italic	64
enlarged	32
double-strike	16
emphasized	8
condensed	4
elite	1
pica	0

For any combination, just add up the values of each of the modes you want and use the total as the number after <ESC> !. For example, to calculate the code for enlarged italic underlined pica, add the following numbers together:

underline	128
italic	64
enlarged	32
pica	0
	224

To print this combination, therefore, you use <ESC> ! followed by the number 224. In MBASIC the command is:

```
2Ø LPRINT CHR$(27);"!";CHR$(224);
```

To try this or any other number, enter and run this short program, which will ask you for a Master Select number and then give you a sample of printing using that code. Again, if you are using a computer with BASIC that does not use the LPRINT command, see Appendix F.

```
1Ø INPUT "Master Select number";M
2Ø LPRINT CHR$(27)"!"CHR$(M)
3Ø LPRINT "This sample of printing uses "
4Ø LPRINT "Master Select number";M
5Ø LPRINT CHR$(27)"@"
```

In this program, you can use any number you have calculated with the formula above, but remember that emphasized cannot combine with condensed or elite. If you try to combine emphasized with either of the two narrow pitches, you will not harm the printer; it will simply use a priority list in its memory to determine which mode to use. This priority list causes a combination of emphasized and elite to produce elite only, a combination of emphasized and condensed to produce emphasized only, and a combination of all three to produce condensed elite.

Master Select is a powerful code that gives you an easy way to produce multiple combinations with a single command. To see double-strike emphasized italic printing, for example, you need only one <ESC> code instead of three.

Indeed, Master Select is such a powerful feature that it may occasionally be more powerful than you want it to be. Because it controls eight different modes, a Master Select code will cancel any of those

eight that are not selected. For example, suppose that you have a page in elite and want part of it to be printed in italic. If you use <ESC> ! 64 to turn on italic, the LX-80 will begin printing in italic pica instead of italic elite because the 64 code does not include elite. Use 65 for italic elite.

If you are not using BASIC, and therefore do not have a command like CHR$( ) to send an ASCII code simply by inserting a number in the command, you will have to find a character which corresponds to the required number. Appendix A may help you, or there may be a similar table in your computer manual. In all cases the number referred to in the command must be sent as an ASCII code. As an example of using a character instead of a number, if you wish to send the sequence <ESC> ! 65 to set italic elite, you should send <ESC> ! A, since the letter A has the ASCII code 65.

Superscript and Subscript

Your LX-80 can also print superscripts and subscripts, which you can use for mathematical formulae, footnotes, and other items that require numbers or letters above or below the usual print line. <ESC> S0 turns on superscript and <ESC> S1 turns on subscript. <ESC> T turns off either one. You can enter either <ESC> S0 or <ESC> S1 in the master program, but that will print the whole sentence in superscript or subscript. Some more realistic examples are below:

```
E=MC²
H₂Ø
This fact is found in three sources.⁷
```

As you can see, you can use superscript or subscript for an individual character. Just find out how to send printer codes in your applications program; then send the proper codes to the printer.

Special Characters

The LX-80 has two groups of special characters that can add distinction to printing. The international set gives you characters used in many different languages, and the special graphics set contains symbols, objects, and line characters that you can combine for artistic effects or business uses.

International Characters

When printing in languages other than English, you will need extra or different characters. The LX-80 has provided for printing in many languages by having 96 international characters in its ROM (Read Only Memory). This total includes characters in three sets: draft, draft italic, and NLQ (Near Letter Quality).

In order to print any of these characters, first select one of the following character sets and then use the individual characters within that set.

0	USA	6	Italy
1	France	7	Spain
2	Germany	8	Japan
3	United Kingdom	9	Norway
4	Denmark I	10	Denmark II
5	Sweden		

You select the character set in one of two ways: with an <ESC> code or with a switch in the back of the printer. The <ESC> code in BASIC has the following format:

```
LPRINT CHR$(27)"R"CHR$(n)
```

in which n stands for the appropriate number from the list above. In other words, the BASIC command to select the French character set is

```
LPRINT CHR$(27)"R"CHR$(1)
```

The other method of selecting an international character set is with the small switches, called DIP switches, in the back of the printer. If you plan to use one of the international sets quite a bit, see Appendix D for instructions for using the DIP switches.

Once you have selected a character set, whether you do it with the <ESC> code or the DIP switches, you will be able to print several new characters. The character sets are shown in Tables 6-1, 6-2, and 6-3.

Table 6-1. International characters in NLQ mode

	35	36	64	91	92	93	94	96	123	124	125	126
USA	#	$	@	[	\	]	^	`	{	¦	}	~
FRANCE	#	$	à	°	ç	§	^	`	é	ù	è	¨
GERMANY	#	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß
UK	£	$	@	[	\	]	^	`	{	¦	}	~
DENMARK I	#	$	@	Æ	Ø	Å	^	`	æ	ø	å	~
SWEDEN	#	¤	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
ITALY	#	$	@	°	\	é	^	ù	à	ò	è	ì
SPAIN	₧	$	@	¡	Ñ	¿	^	`	¨	ñ	}	~
JAPAN	#	$	@	[	¥	]	^	`	{	¦	}	~
NORWAY	#	¤	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü
DENMARK II	#	$	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü

Table 6-2. International characters in draft mode

	35	36	64	91	92	93	94	96	123	124	125	126
USA	#	$	@	[	\	]	^	`	{	¦	}	~
FRANCE	#	$	à	°	ç	§	^	`	é	ù	è	¨
GERMANY	#	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß
UK	£	$	@	[	\	]	^	`	{	¦	}	~
DENMARK I	#	$	@	Æ	Ø	Å	^	`	æ	ø	å	~
SWEDEN	#	¤	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
ITALY	#	$	@	°	\	é	^	ù	à	ò	è	ì
SPAIN	₧	$	@	¡	Ñ	¿	^	`	¨	ñ	}	~
JAPAN	#	$	@	[	¥	]	^	`	{	¦	}	~
NORWAY	#	¤	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü
DENMARK II	#	$	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü

Table 6-3. International characters in draft italic

	35	36	64	91	92	93	94	96	123	124	125	126
USA	#	$	@	[	\	]	^	`	{	¦	}	~
FRANCE	#	$	à	°	ç	§	^	`	é	ù	è	¨
GERMANY	#	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß
UK	£	$	@	[	\	]	^	`	{	¦	}	~
DENMARK I	#	$	@	Æ	Ø	Å	^	`	æ	ø	å	~
SWEDEN	#	¤	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
ITALY	#	$	@	°	\	é	^	ù	à	ò	è	ì
SPAIN	₧	$	@	¡	Ñ	¿	^	`	¨	ñ	}	~
JAPAN	#	$	@	[	¥	]	^	`	{	¦	}	~
NORWAY	#	¤	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü
DENMARK II	#	$	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü

The number at the top of each column in the tables is the ASCII code that prints the characters in that column.

Once you have selected an international character set with the DIP switches or the <ESC> R code, you can use the tables to see which characters on the standard USA keyboard will produce the international characters you want. Simply type the character from the top row of one of the figures in order to print the corresponding character in the row of the set you have chosen. For example, if you have reset the DIP switches for the UK character set and you press the # key, the £ symbol will be generated. Even though you will see the # symbol on the screen, the £ symbol will be printed on the paper. For another example, if you have selected the Swedish character set and you press the @ key, the É symbol will be generated.

If your keyboard does not have one of the keys that you need, find the character you want to send and then look down the column to find which character corresponds to that character in your country. If your computer is using a standard ASCII set, and you have set the international characters using the <ESC> R command, when you print the character you have found on your keyboard, it will be printed as the corresponding character for the country you have chosen. If the result is wrong compare the table in Appendix A with the corresponding chapter in your computer manual.

Graphics Character Set

The LX-80 printer's Read Only Memory (ROM) also contains the 32 graphics characters that you see in Figure 6-6.

128	129	130	131	132	133	134	135	136	137	138
┼	┴	┬	┤	├	─	│	┌	┐	└	┘
139	140	141	142	143	144	145	146	147	148	149
▒	▓	▃	▌	▟	○	◆	◆	◆	◆	♪
150	151	152	153	154	155	156	157	158	159	
◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	

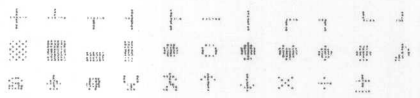
Figure 6-6. Special graphics characters

Undoubtedly you can think of uses for many of the shapes and symbols available in this set, and you can combine the line graphics characters (the ones on the first row) to form various sizes and shapes of boxes and other figures that use straight lines.

To print these graphics characters you must use either a programming language or a computer with a graphics shift or other special key that allows you to send graphics codes. The characters do not have to be the ones in your computer, because the printer does not know which numbers represent which graphics character in your computer. There is no standard to correspond to the ASCII codes for the alphabet for such graphics characters.

Sending the codes for these characters to the printer is a two-step process just as it is for the international characters. In BASIC, you first send CHR$(27) ; "m" ; CHR$(4) to turn on the graphics character set, then you send the code numbers given in Figure 6-6. After you have used the <ESC> code to turn on the graphics character set, the LX-80 prints the codes from 128 through 159 as graphics characters.

You can change pitch and weight with the graphics characters just as you can with the other characters in the ROM of the LX-80. The characters in Figure 6-6 are printed in enlarged elite. The printout below shows the characters in pica:



The next printout shows the characters in emphasized enlarged pica:

The design of all the special graphics characters is shown in enlargements in Appendix A.

Because normal line spacing leaves space between the lines of graphics characters just as it does between lines of text, you must change the line spacing when you combine line graphics characters. Further details on setting line spacing are given in Chapter 7.

Although you can use any print mode with the graphics characters, you should not use elite or condensed. These modes cause small gaps in horizontal lines formed by a combination of line graphics characters.

Chapter 7
Page Formatting

The LX-80 printer has many sophisticated commands to set margins, line spacing, and horizontal and vertical tabs. Most of these functions are duplicated by applications programs which use them in calculations for the layout you have specified in the program. This chapter describes a few commands that the average user might need. If you want more information, you can find all the commands in Appendices B and C.

Top of Page and Page Length

When you are printing a long document using continuous paper it is important to make the individual pages of the document fit correctly on each page. If the paper is not set in the printer correctly, the pages will start being printed in the centre of one of the sheets of paper, the middle will be on the perforation, and the end will be in the middle of the next sheet. When you switch the printer on, it assumes that the paper is in the correct position at the top of the page. Consequently if you move the paper using the paper feed knob, the printer (or indeed your applications software) does not know this has happened and gets out of step with the actual top of the page. The best way to set the top of page and make sure the printer keeps the page is as follows:

When you have inserted a new piece of continuous paper, move the paper forward until the first perforation sits level with the top of the ribbon guide (Figure 1-6) using the paper feed knob. You then need to tell the LX-80 that it is at the top of the paper. You can do this by sending a software initialization command <ESC> @ as in Chapter 5, or more conveniently by switching the power off and on again.

When you move the paper, do so by pressing the ON LINE button so that the printer is off-line, and then using the LF button to move it up individual lines or the FF button to move the paper to the top of the next page. If you do move the paper using the paper feed knob and you wish to check whether you have disturbed the top of page setting, use the FF button with the printer off-line to move the paper to where the LX-80 thinks the top of page is. Having found that it is not at the perforation, turn the paper feed knob to move the perforation to be in line with the top of the ribbon guide.

The distance travelled by the page when you press the FF button or when computer sends a form feed command is normally 11 inches. If your pages are of a different length you can adjust the length in two ways. One of the DIP switches described in Appendix D allows you to specify the page length as 11 or 12 inches. You can also specify the length using a code sequence. There are two ways to make the specification. The code <ESC> C sets the length of the page by the number of lines at the current line spacing. The code <ESC> C0 sets the page length as a number of inches. The full syntax for using these codes is given in Appendix C.

Paper-Out Sensor

Under the platen (the black roller) of the LX-80 printer is a small switch that senses whether or not paper is in the printer. When the end of the paper passes this switch, it sends a signal that sounds the beeper and stops the printing. This is not only to save wear on the print head, ribbon and platen, but necessary to make sure that printing stops if you are printing a document on single sheets of paper and have to change the paper. The switch is at the back of the platen and so some distance from the head and so printing stops about 2 inches from the end of the page. Therefore, if you use single-sheet paper in the LX-80, you cannot print on the last 2 inches of each page without overriding this feature.

The paper-out sensor can be deactivated in two ways. One is a temporary solution using the code sequence <ESC> 8 to deactivate the paper-out sensor. You can send the <ESC> 9 code to set it on again. The second method is to permanently deactivate it by changing one of the DIP switches as described in Appendix D.

Although you can print to the end of the page with single-sheet paper, you must be careful. If the computer software does not realize you have to change the paper and does not tell you to change the

paper and signal you have done so, printing will continue onto the platen and the text you are trying to print out will have to be reprinted from that point. Most word processors have an option to allow you to work with single sheets of paper.

Some computer systems, however, ignore the <ESC> code and the DIP switch setting. If <ESC> 8 or the DIP switch setting does not solve this problem for you, see Appendix F for other solutions.

Skip Over Perforation

If you are using continuous pin-feed paper for printing program listings or other material not controlled by an applications program, you may find that the LX-80 prints right over the perforations between pages. The LX-80 has an <ESC> code to prevent this: the <ESC> N command. You send <ESC> N followed by the number of lines you want the LX-80 to skip at the bottom of a page. For example, in BASIC the following line will make the LX-80 skip six lines after each 60 lines:

```
1Ø LPRINT CHR$(27)"N"CHR$(6);
```

Since a standard page is 66 lines, this will give you one inch of blank space at the bottom of each page. If you prefer to have half of the blank space at the top of the page and half at the bottom, simply set the top of page approximately three lines (1/2 inch) below the perforation as described above.

Margins

The LX-80 allows you to set the left and right margins with simple <ESC> sequences. The left margin command is <ESC> l followed by the number of the column you choose for the left margin. The right margin command is <ESC> Q followed by the column number of the right margin you want. For the left margin command, be sure to use a lower case letter **l**, not the figure one.

If the word processing program does not allow you to change the margins, you can send margin commands to the LX-80 in BASIC or another programming language before you print your documents. For example, if you prefer wider margins than your word processing program allows, run the following BASIC program before printing. This program gives you a left margin of 10 and a right margin of 60, but you can use any numbers you prefer for the margin commands.

```
10 LPRINT CHR$(27)"l"CHR$(10);
20 LPRINT CHR$(27)"Q"CHR$(60);
```

Such a program will also allow you to choose the margins you prefer for program listings. Just remember that once you run a program that sets margins, those margins remain in effect until you change them with new margin commands or turn off or reset the printer.

You should be aware that a few applications programs reset the printer before each document or file they print. These programs will, of course, cancel the new margin settings. See Chapter 2 to find out how to test for a reset code in your program.

The maximum right margins on the LX-80 printer are 80 in pica, 96 in elite, 137 in condensed, and 160 in condensed elite. For further information on this command see Appendix B.

Line Spacing

Ordinarily you don't have to concern yourself with how the printer moves the paper so that it doesn't print lines of text on top of one another. The LX-80 takes care of this without any special instructions. However, if you want to understand how line spacing works or you need to change the line spacing for a special application such as graphics, read this brief explanation of line spacing on the LX-80.

The movement of the paper between lines is called a line feed and the distance the paper moves is called a line space. In ordinary printing the line spacing is 1/6-inch, which produces six lines of print per inch. Figure 7-1 will help you visualize this spacing. As you can see in the figure, the standard (default) spacing is the same as 12 rows of dots. Since the LX-80 characters use nine rows of dots, the 12-dot line spacing leaves three blank rows between the lines of text.

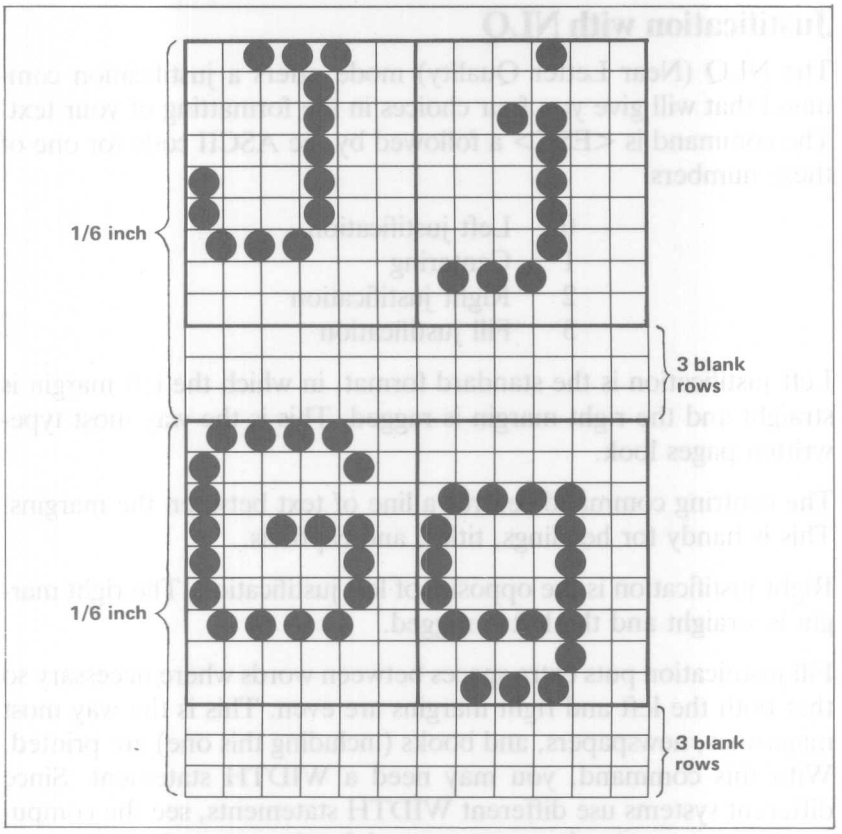


Figure 7-1. Standard line spacing

The default line spacing illustrated in Figure 7-1 is the only one you need for almost all printing of text, but in some cases you may want to increase or decrease the space between lines. The LX-80 has several commands to do this. <ESC> 0 decreases the line spacing to 9-dot (9/72-inch), <ESC> 1 decreases it to 7-dot, and <ESC> 2 returns it to 12-dot.

In addition, there are commands to specify the line spacing in 72nds of an inch and 216ths of an inch. If you need to make such fine adjustments in the line spacing, see Appendix B for the proper commands. In the chapter on dot graphics you will see how useful <ESC> 1 can be.

Justification with NLQ

The NLQ (Near Letter Quality) mode offers a justification command that will give you four choices in the formatting of your text. The command is <ESC> a followed by the ASCII code for one of these numbers:

0	Left justification
1	Centering
2	Right justification
3	Fill justification

Left justification is the standard format, in which the left margin is straight and the right margin is ragged. This is the way most typewritten pages look.

The centring command centres a line of text between the margins. This is handy for headings, titles, and captions.

Right justification is the opposite of left justification. The right margin is straight and the left is ragged.

Fill justification puts extra spaces between words where necessary so that both the left and right margins are even. This is the way most magazines, newspapers, and books (including this one) are printed. With this command, you may need a WIDTH statement. Since different systems use different WIDTH statements, see the computer or programming language manual for the proper format.

In using justification modes in the printer, you must send all characters to the printer one paragraph at a time. If you are using a word processor, it will calculate the numbers of characters on a line and split the words in the correct place. Thus you should not set justification in the printer if your word processor is also set to use it, since the two will conflict and you will not be able to predict the outcome.

When you use any of the justification commands, ensure that you have set NLQ mode first.

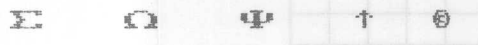
Chapter 8
User-Defined Characters

The LX-80 has 416 different characters stored in its ROM (Read Only Memory). This number includes draft, italic, international, special graphics, and Near Letter Quality characters. For those occasions when you need a special character or a few letters in a different typeface, the LX-80 allows you to create your own characters and print them just as if they were ordinary letters. You can only redefine six characters at a time.

Making full use of this facility requires that you have to write a program to create the characters. The programs in this chapter have been designed to do most of the work for you.

Defining Your Own Characters

The printout below displays a few such characters to give you an idea of what can be done. These characters are truly user-defined —you create what you need or want.



It may seem that designing a character and telling the LX-80 how to print it is complicated. In reality it is a routine procedure once you know what to do. The task has been reduced to a simple three-step process: planning your character, running one program that tests your work and calculates the required DATA numbers, and running another program to put the character in your printer's RAM (Random Access Memory) for use whenever you need it.

Because the high-resolution NLQ (Near Letter Quality) mode uses many more dots per character than the draft mode, defining NLQ characters is somewhat more complex than defining draft characters. A separate program for defining NLQ characters can be found at the end of this chapter.

After you have created your own characters with these programs, certain characters which you seldom use will be printed as the user-defined characters. For example, you could type = to print ↑.

Your user-defined characters can be utilitarian or imaginative, anything from a scientific symbol to script letters for your initials. Just follow the simple steps below.

The only restriction on your creativity is that the characters you define must follow the same rules that govern the rest of the characters printed by the LX-80. They must fit into an 11×9 matrix, no dot can overlap another, and either the top or the bottom row must be empty. Look at the enlargements of the characters in Chapter 3 and Appendix A to see how the standard LX-80 characters are designed.

Designing Process

Suppose you need the Greek letter sigma (Σ) in your work. Although the LX-80 has a number of special symbols, the sigma is not one of them. You can, however, create and print such a symbol with ease. First, use a grid like the one in Figure 8-1 to plan where to place the dots.

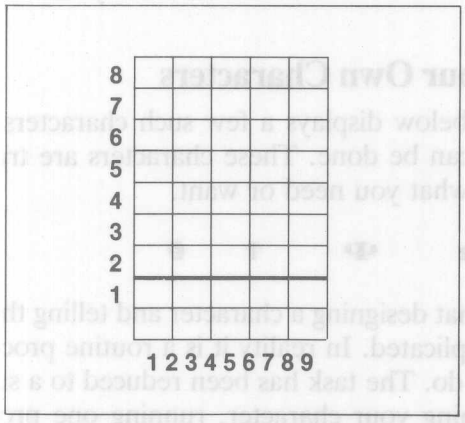


Figure 8-1. Grid for designing draft characters

Because the last two columns are reserved for the space between characters, they have not been included in the grid. And since most characters do not use the bottom two rows, a heavy line has been used to indicate the usual lower limit for an LX-80 character.

In placing dots on the grid you should remember that you are building up columns of dots to be printed as the head moves across the paper. When you place dots on this grid, remember that dots cannot go on horizontal lines, but they can go on vertical lines so long as they do not overlap any other dots. As you design your characters, draw the dots as large as you see them in the example on the left in Figure 8-2. If you draw them smaller, you may have overlapping dots without realizing it.

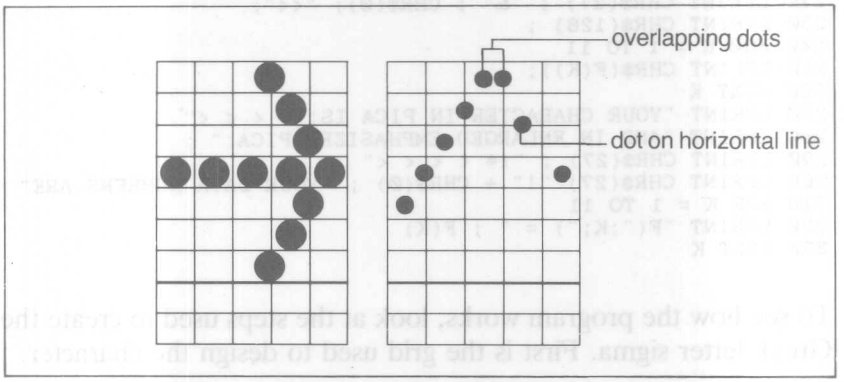


Figure 8-2. Correct and incorrect designs

It does not matter if you do accidentally make some of the dots overlapping. The program will still work, but only one of the dots will be printed.

First definition program

Once you have drawn your dots on the grid, type in the following BASIC program and run it. If you are using a slightly non-standard BASIC such as Applesoft BASIC, see Appendix F.

```
100 DIM F(11)
110 FOR J = 1 TO 9
120 PRINT "WHICH ROWS HAVE DOTS IN COLUMN "; J
130 INPUT R : IF R = 0 THEN 180
140 IF R > 8 THEN PRINT "INVALID ": GOTO 130
150 F(J) = F(J) + 2 ^ (R-1)
160 IF F(J) > 255 THEN F(J) = 255
170 GOTO 130
180 NEXT J
190 LPRINT CHR$(27) ; "x" ; CHR$(0) ;
200 LPRINT CHR$(27) ; ":" ; CHR$(0) ; CHR$(0) ; CHR$(0);
210 LPRINT CHR$(27) ; "%" ; CHR$(1) ; CHR$(0) ;
220 LPRINT CHR$(27) ; "&" ; CHR$(0); "<<";
230 LPRINT CHR$(128) ;
240 FOR K = 1 TO 11
250 LPRINT CHR$(F(K));
260 NEXT K
270 LPRINT "YOUR CHARACTER IN PICA IS: < < < <"
280 LPRINT "AND IN ENLARGED EMPHASIZED PICA:" ;
290 LPRINT CHR$(27) ; "!* < < < <"
300 LPRINT CHR$(27) "!" + CHR$(0) ; "YOUR DATA NUMBERS ARE"
310 FOR K = 1 TO 11
320 LPRINT "F(";K;") = " ; F(K)
330 NEXT K
```

To see how the program works, look at the steps used to create the Greek letter sigma. First is the grid used to design the character.

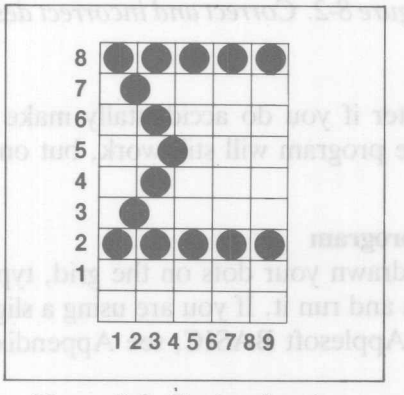


Figure 8-3. Design for sigma

If you are only interested in running the program to obtain the numbers used to design your own characters, you can move on to the next section. If you are a programmer and wish to understand the steps, the following breakdown of the program steps will be of use to you.

Line 100 sets up an array for the numbers corresponding to the 11 columns of dots required for a character.

Lines 110-180 allow you to input which of the dots are to be used in a particular column and then convert the dots into a number the LX-80 understands. When you have finished a column, simply press the RETURN key. Line 140 also makes sure that a row greater than 8 is not input. Also if one row is input more than once so that the value for the column goes over 255, it keeps it at that value. This corresponds to a full vertical line. The loop does not allocate values to the two columns at the right since they are left blank in order to give spaces between the characters.

Line 190 makes sure that draft mode is set, since this method of defining the characters only works in this mode.

Line 200 copies the ROM character set into RAM so that it can be redefined.

Line 210 sets the alternate character set.

Line 220 tells the LX-80 you are going to define the character "<".

Line 230 sets an attribute to use the top 8 pins of the head. If you want the bottom 8 pins to be used make this 0 instead of 128.

Lines 240-260 send the data corresponding to the way the pins are to be fired, which has been stored in the array.

Lines 270-290 print the character out in normal pica and also in enlarged emphasized pica.

The remainder of the program shows you the values of the numbers in the arrays.

Running the program

For each of the nine columns, the program will ask for the numbers of the rows in which you want dots to appear. Enter the row numbers one at a time, pressing the RETURN key after each one. When you have entered all the numbers for a column or when you want no dots in a column, press RETURN without a number. Remember that the vertical lines in the grid are the even-numbered columns.

In our example, the program first asks what rows have dots in column 1. Respond with 8, RETURN, and 2, RETURN to indicate that you want dots in rows 8 and 2. Then press RETURN alone to indicate that no more dots go in column 1. For column 2 (the vertical line) enter 7, and 3, with a RETURN after each of them. Then enter RETURN to finish with column 2 and go on to column 3.

For column 3 enter 8, 6, 4, and 2. (From now only the numbers will be given not the necessary RETURN each time.) For column 4 enter 5; for column 5 enter 8 and 2; in column 6 there are no dots, so press RETURN only; for column 7 enter 8 and 2; for column 8 RETURN only; for column 9 enter 8 and 2.

Now wait a moment for your computer to calculate the dot patterns and your LX-80 to print the new character in two different typestyles. Your printout also gives you eleven numbers, which you will use in the next program. You should get the printout you see below:

```
YOUR CHARACTER IN PICA IS: Σ Σ Σ Σ
AND IN ENLARGED EMPHASIZED PICA:  Σ  Σ  Σ  Σ
YOUR DATA NUMBERS ARE
F( 1 ) =  130
F( 2 ) =  68
F( 3 ) =  170
F( 4 ) =  16
F( 5 ) =  130
F( 6 ) =  0
F( 7 ) =  130
F( 8 ) =  0
F( 9 ) =  130
F( 10 ) =  0
F( 11 ) =  0
```

When you get to this point with a character of your own, you see how it looks and whether or not you like it. If you want to make any changes, move the dots as needed and re-run the program.

If you want to put dots in the bottom row, change the number in line 190 from 128 to 0. Then the usable rows will be as shown in Figure 8-4 below.

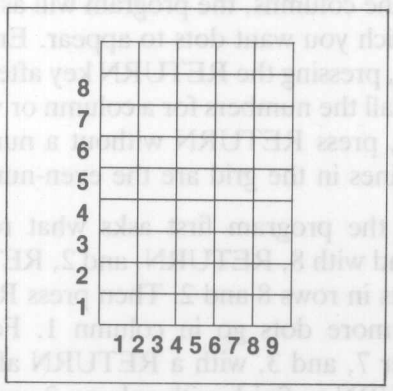


Figure 8-4. Using the bottom eight rows

Second definition program

Once the character looks the way you want it to, enter, modify, and run the next program. The program as listed creates the sigma character, and two others. You can use it to redefine any of the possible six characters : ; < = > and ? by adding more data statements as will be explained later.

```
100 LPRINT CHR$(27) ; "x" ; CHR$(0) ;
110 LPRINT CHR$(27) ; ":" ; CHR$(0) ; CHR$(0) ; CHR$(0);
120 LPRINT CHR$(27) ; "%" ; CHR$(1) ; CHR$(0);
130 READ A$
140 IF A$ = "XX" THEN END
150 LPRINT CHR$(27) ; "&" ; CHR$(0); A$; A$; CHR$(128);
160 FOR K = 1 TO 11
170 READ F : LPRINT CHR$(F);
180 NEXT K
190 REM Display characters
200 LPRINT CHR$(27) ; "%" ; CHR$(0) ; CHR$(0) ;
210 LPRINT A$ ;"  becomes  ";
220 LPRINT CHR$(27) ; "%" ; CHR$(1) ; CHR$(0) ;
230 LPRINT A$
240 GOTO 130
250 DATA "<",130,68,170,16,130,130,130,198,198,0,0
260 DATA "=",112,8,0,138,116,138,0,8,112,0,0
270 DATA ">",58,68,2,128,0,128,2,68,58,0,0
280 DATA "XX"
```

This program works in a similar way to the previous program, but instead of inputting the data from the keyboard, the data is embedded in the program as data statements. You can use the previous program to design the characters and when you have it correct, make a permanent program with this one. The program has been written to allow you to add them without making any other changes. However, you must put the new lines before line 280.

Check your work by making sure that there are eleven numbers in each line and that the numbers are separated by commas. Unless you want the characters to join onto one another without spaces, always make the last two values zero.

Running the program

When you run this second program, it shows which characters have been redefined, for example:

```
<  becomes  Σ
=  becomes  Ψ
>  becomes  Ω
```

The new characters will be stored in the memory of the LX-80 until the printer is switched off, or receives the reset code. You can switch between the ROM characters and the defined ones by using the <ESC> % code.

If you have designed a few characters and want to use them with a word processing program, for example, just run the second definition program before you start using the word processing program. Then use the printout as your guide to which keys to press for your new characters.

Defining NLQ Characters

Since NLQ characters use many more dots than draft characters, defining NLQ characters is more complex than designing draft ones. If you use the grid and the programs in this section, however, you should find it easy to do.

NLQ grid

Because the NLQ characters can use as many as 18 dots vertically and 12 dots horizontally, you plan your designs on a different grid to the one you used for draft characters.

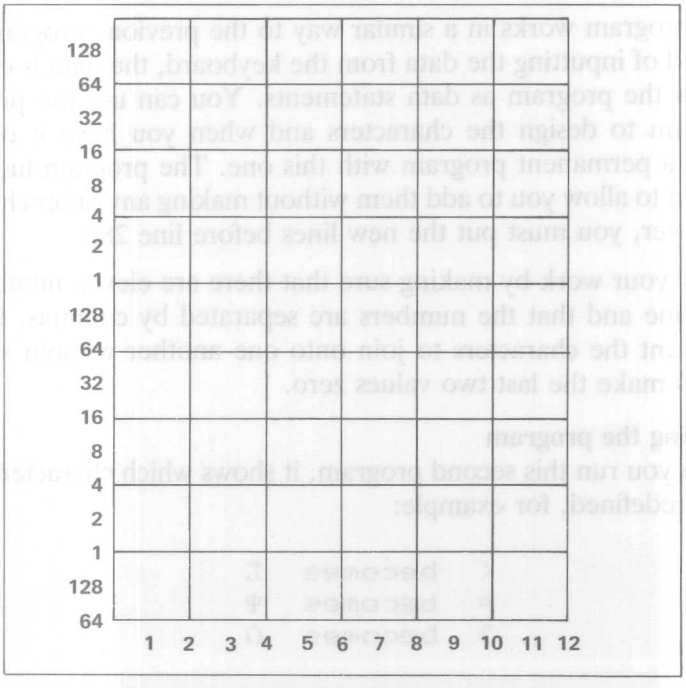


Figure 8-5. Grid for NLQ characters

On this grid you can use any numbered line or space. As you can see, that includes the bottom line and the line on the right side. You should remember to leave one or two columns blank for space between characters, however.

Each NLQ character definition requires 36 data numbers. Therefore, each vertical column must be divided into three sections for the calculation of data numbers. The process is not difficult once you practice using it.

Figure 8-6 shows a single column to make it clear how the data numbers are calculated. In designing NLQ characters you should use circles instead of dots to make it easier to keep track of overlapping dots.

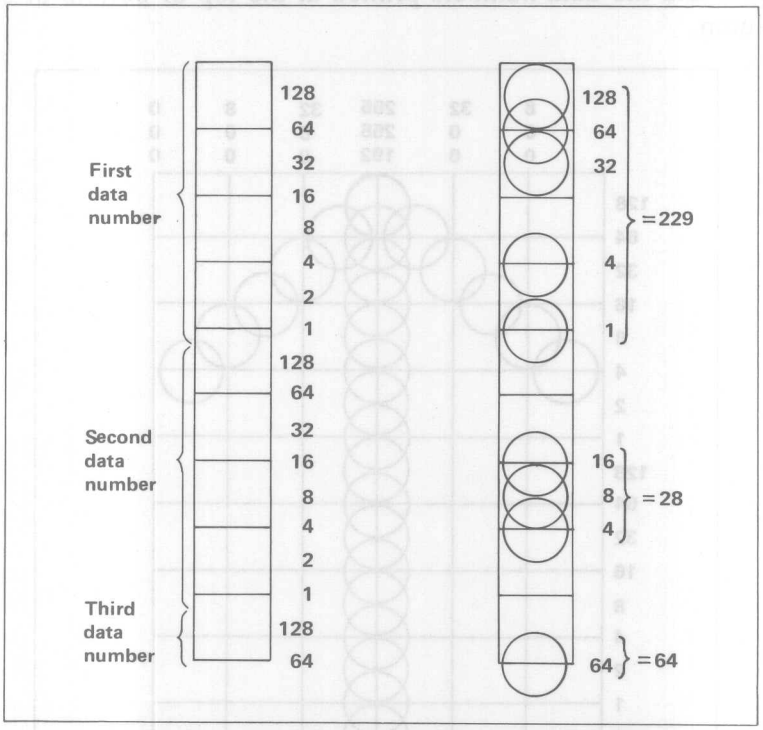


Figure 8-6. Data numbers for one column

To calculate the data numbers for this column, you will need to find three different numbers. First find out which dots are used in the top group (the top eight positions) and add their values together. Then you go down to the middle group (the next eight positions) and add the values of any dots that are used there. Finally, look at the bottom group (two dot positions) and add together the values used there.

If no dots are used in a group, the data number for that group is zero. All zeros must be entered in the DATA statements for the NLQ definition programs.

Now as an example the previous program will be modified to produce an arrow in NLQ mode. Figure 8-7 shows the design drawn on a grid and the data numbers printed at the top or bottom of each column.

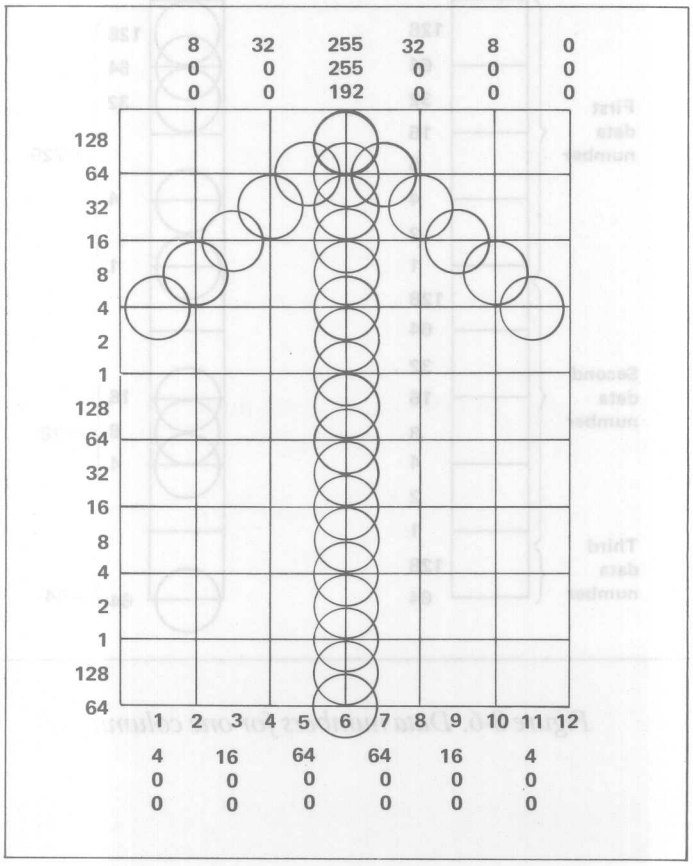


Figure 8-7. Arrow design and data numbers

If you look at each column individually, you can see how the data numbers were calculated.

NLQ definition program

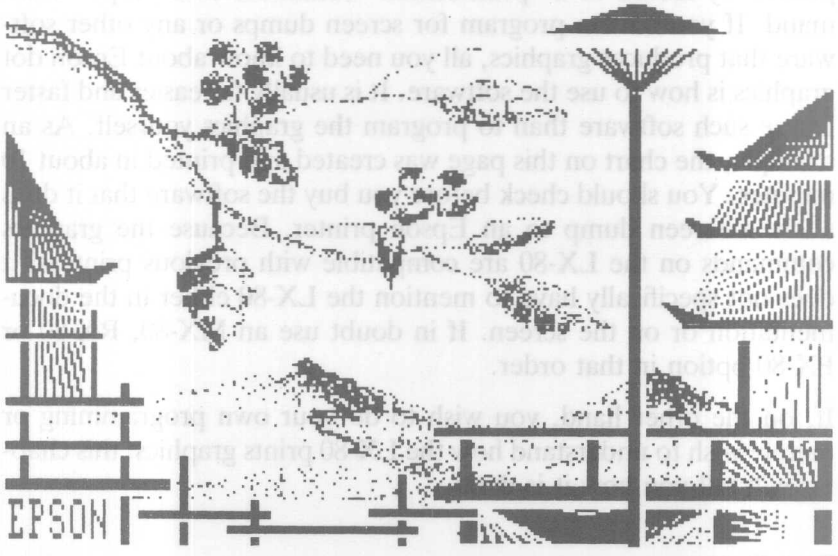
Now type in and run the following program. It has the data numbers for the arrow design. For a character of your own, change the data numbers in lines 250 –270 or you can add up to six characters with more data statements as in the previous program. Again you must put all your data before statement in line 280.

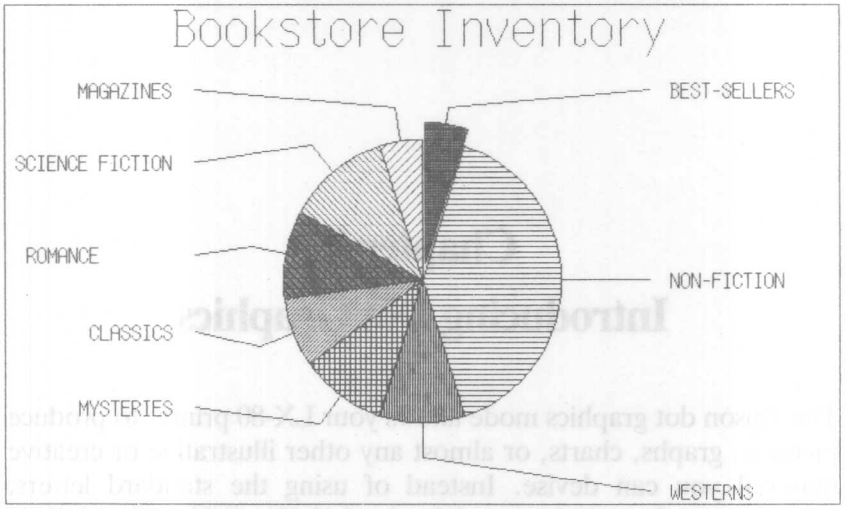
```
100 LPRINT CHR$(27) ; "x" ; CHR$(1) ;
110 LPRINT CHR$(27) ; ":" ; CHR$(0) ; CHR$(0) ; CHR$(0);
120 LPRINT CHR$(27) ; "%" ; CHR$(1) ; CHR$(0) ;
130 READ A$
140 IF A$ = "XX" THEN END
150 LPRINT CHR$(27) ; "&" ; CHR$(0); A$; A$;
155 LPRINT CHR$(0) ; CHR$(12); CHR$(0);
160 FOR K = 1 TO 36
170 READ F : LPRINT CHR$(F);
180 NEXT K
190 REM DISPLAY CHARACTERS
200 LPRINT CHR$(27) ; "%" ; CHR$(0) ; CHR$(0) ;
210 LPRINT A$ ; "   becomes   ";
220 LPRINT CHR$(27) ; "%" ; CHR$(1) ; CHR$(0) ;
230 LPRINT A$
240 GOTO 130
250 DATA "<", 4,0,0,8,0,0,16,0,0,32,0,0
260 DATA 64, 0,0,255,255,192,64,0,0,32,0,0
270 DATA 16,0,0,8,0,0,4,0,0,0,0,0
280 DATA "XX"
```

When you run this program for your own character, you find out whether or not it looks right to you. If it doesn't, move the dots as needed, recalculate and change the data numbers, and run the program again.

Chapter 9
Introducing Dot Graphics

The Epson dot graphics mode allows your LX-80 printer to produce pictures, graphs, charts, or almost any other illustrative or creative material you can devise. Instead of using the standard letters, numerals, and symbols stored in the LX-80's ROM (Read Only Memory), the graphics mode prints columns of dots on a line and the picture is built up from the dots. For large pictures more than one line will be necessary.





In many cases you may wish to use commercial programs to design graphics on a screen. Most of these programs perform what is called a screen dump, in which whatever is on the computer screen is sent to, and printed by, the printer. This function is sometimes accomplished by means of a "print screen" command or a "copy" command. If you have a program for screen dumps or any other software that produces graphics, all you need to know about Epson dot graphics is how to use the software. It is usually far easier and faster to use such software than to program the graphics yourself. As an example, the chart on this page was created and printed in about 10 minutes. You should check before you buy the software that it does allow a screen dump to an Epson printer. Because the graphics commands on the LX-80 are compatible with previous printers, it does not specifically have to mention the LX-80 either in the documentation or on the screen. If in doubt use an MX-80, RX-80 or FX-80 option in that order.

If, on the other hand, you wish to do your own programming or merely wish to understand how the LX-80 prints graphics, this chapter will tell you how it is done.

Dot Patterns

The LX-80 forms graphic images approximately the same way that pictures in newspapers and magazines are printed. If you look closely at a newspaper photograph, you can see that it is made up of many small dots. The LX-80 also forms its images with patterns of dots. In designing the graphics on the printer, you have to use a

program to decide which dots are filled in and which are left blank. It is often better to use squared graph paper to make up the design, and then transfer the dot pattern to the program. In order to do this it is necessary to understand how the print head transfers the dots to the paper.

Print Head

The graphics mode on the LX-80 is quite different from the text modes. Instead of sending codes for letters and printing functions, the codes you send are ones that print a pattern of dots in a column. None of the predefined characters or symbols in the printer's memory is used. Your program controls exactly where each dot is printed, column by column and line by line.

The columns are defined by the row of pins on the print head. In the standard graphics mode it uses only the top eight pins on the print head because the computer uses eight data lines to communicate with the printer. Each of the top eight pins of the print head corresponds to one of the data lines. There is also a graphics mode which allows all nine pins of the head to be used.

When you want to print figures more than eight dots high, it is necessary to print on a new line, advancing the paper and printing another line, just as you would with text. To keep the print head from leaving gaps between the graphics lines as it does between the text lines, the line spacing must be adjusted to eliminate this gap. When the line spacing is properly adjusted, the LX-80 prints finely detailed graphics images that give no indication that they are made up of separate lines, each no more than 1/8 of an inch high.

To ensure the proper alignment of dots in figures that use more than one line, the LX-80 abandons the bidirectional printing it uses for draft text. Instead it prints from left to right only in graphics mode.

It is not necessary to fill the whole page or even an entire line with your graphics figures. However, before you send the data corresponding to the columns of the pattern, you must tell the printer how much data to expect. This information is part of the graphics command.

Graphics Mode

The graphics mode command is quite different from the other commands covered so far in this manual. For most of the other LX-80 modes, such as italic and emphasized, one ESCape code turns the mode on and another turns it off. With graphics, the commands are more complicated because the code that turns on a graphics mode also specifies how many columns it will use.

The LX-80 has several different graphics densities. Initially, to keep things simple, only one will be described. Once you have mastered this the others will be straightforward. This graphics mode is called single density mode and its ESCape code is:

<ESC> K n1 n2.

The values of n1 and n2 are a sequence of two ASCII codes which determine the number of columns of graphics data to be printed on a line. You can calculate the values of n1 and n2 from the number of columns n as follows:

n1 = remainder on dividing n by 256
n2 = the integer (i.e. the whole number) part of the division of n by 256

In Microsoft BASIC these values would be obtained from the expressions:

n1 = n MOD 256
n2 = INT (n/256)

Some versions of BASIC do not have the MOD function. In this case, the expressions used will be:

n1 = n - n2 * 256
n2 = INT (n/256)

Since calculation of n1 requires the value of n2, you will have to calculate n2 first.

When you have carried out the calculation, you can then use the following line in a Microsoft BASIC program:

```
LPRINT CHR$(27)"K"CHR$(N1)CHR$(N2);
```

The number of columns reserved is the first number plus 256 times the second number. Since the command is set up for two numbers, you must supply two even if you only need one. When you need less than 256 columns, just make n1 the number of columns you are reserving and make n2 a zero.

If you are a simply trying to use the command to produce graphics, and are not concerned with the technicalities, you can move on to the next section to learn how to define the codes for producing the patterns. For the more advanced programmer, the graphics command requires more than one number to specify how many columns to reserve because as many as 1920 columns are possible in graphics printing. Since the LX-80 uses 8-digit binary numbers, it cannot accept decimal numbers larger than 255. The number of columns has to be split into a 16-bit number, with the low byte sent after the command and then the high byte.

Pin Numbering

Once you have put the printer into graphics mode and reserved the number of columns you want, your next step is to tell the print head which pins to fire in each column. There are 256 possible combinations of eight pins. Sending one number prints one column. The number is sent as an ASCII code. The numbering system for specifying a particular one of the 256 patterns you want is shown in Figure 9-1.

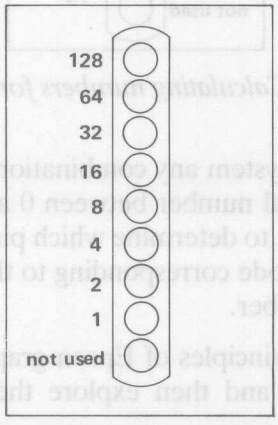


Figure 9-1. Pin numbering

If you only want to fire one pin, send the ASCII code corresponding to its number. To fire more than one pin at the same time, add up the numbers corresponding to the pins you wish to fire and send the ASCII code of the sum to the printer. For example if you want to fire just the top pin send ASCII code 128. To fire just the bottom pin send ASCII code 1. To fire both the top and bottom pin in the same column, send ASCII code 129.

By adding the appropriate numbers together, you can fire any combination of pins. Figure 9-2 shows you three examples of how to calculate the number that will fire a particular pattern of pins.

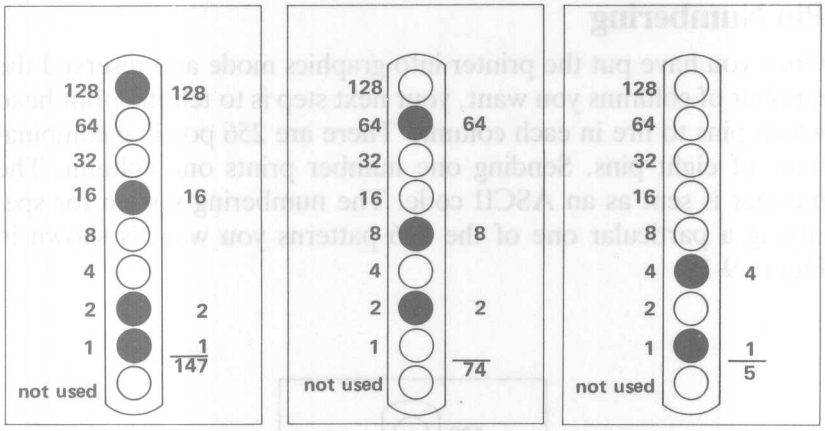


Figure 9-2. Calculating numbers for pin patterns

With this numbering system any combination of the eight pins adds up to a unique decimal number between 0 and 255. Although you use a decimal number, to determine which pins are to be fired, since you send the ASCII code corresponding to the number, the printer receives a binary number.

Having covered the principles of Epson graphics, it is time to produce some programs and then explore the more complex commands.

First Graphics Program

Rather than produce a complex line of graphics the first graphics program prints the same pattern 40 times. In this way you can see a clear result from inputting code to one column whereas just printing one column would require a microscope to determine whether the pattern was correct.

The first line is the code for 40 columns of single-density graphics. As usual, the example is in Microsoft BASIC.

```
1Ø LPRINT CHR$(27)"K"CHR$(4Ø)CHR$(Ø);
```

The second line is the data that fires the pins. Note how it has been derived from the pattern in the middle diagram of Figure 9-2. It simply prints the data 40 times.

```
2Ø FOR X=1 TO 4Ø: LPRINT CHR$(74);: NEXT X
```

The data must be received by the printer as a continuous set with no intervening carriage returns or line feeds. So be extra careful that the semi-colons are present in both lines.

It is a simple program and the result is:

Although it is not as interesting or as complex as the examples at the beginning of this chapter, it does allow you to see exactly how the mode works.

Multiple-Line Exercise

Having found out how to enter and run a simple graphics program, the next exercise shows how the LX-80 combines several lines of graphics for a figure taller than eight dots.

Start with a line for 100 columns of single-density graphics and lines to print two pin patterns. Notice that since there are two pin patterns in the loop, it is only executed 50 times.

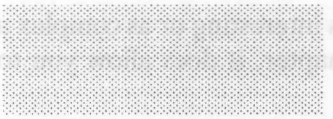
```
30 LPRINT CHR$(27)"K"CHR$(100)CHR$(0);
40 FOR X=1 TO 50: LPRINT CHR$(85)CHR$(42);
50 NEXT X
```

If you run the program now, you will see how one line of the pattern looks:

To see how more than one line combines to form a figure, enter and run the following program, which uses two of the lines you have already typed and adds several more.

```
10 LPRINT CHR$(27)"1";
20 FOR R=1 TO 3
30 LPRINT CHR$(27)"K"CHR$(100)CHR$(0);
40 FOR X=1 TO 50: LPRINT CHR$(85)CHR$(42);
50 NEXT X: LPRINT
60 LPRINT CHR$(27)"K"CHR$(100)CHR$(0);
70 FOR X=1 TO 50: LPRINT CHR$(42)CHR$(85);
80 NEXT X: LPRINT: NEXT R
90 LPRINT CHR$(27)"@"
```

Now run the program to see the six print lines combine into a pattern:



The short and simple program that produced the pattern demonstrates many elements of graphics programming. In order to point these out it is necessary to break the program down into steps.

Line 10 changes to a 7-dot line spacing, which is the height of the dot patterns used in the program, thereby removing the space between the print lines.

Line 20 begins a loop to produce multiple print lines. Lines 30 and 40 are the same as above, but an LPRINT is added to line 50 to produce a line feed after line 40. Lines 60 and 70 are like lines 30 and 40 except that line 70 uses a reversal of the patterns in line 40. As the loop is executed, the program prints lines 40 and 70 alternately so that the patterns of the print lines will fit together well.

Notice that the graphics command can be in effect for only one print line. The command is in lines 30 and 60 so that it is issued each time a new print line is begun. You cannot print more than one line of graphics without having the graphics command issued each time.

Line 90 is the reset code to return the printer to its defaults.

Density Varieties

Although all the examples so far in this chapter have been in the single-density graphics mode, the LX-80 offers five other eight-pin density modes and two nine-pin ones. Nine-pin graphics is not necessary for most uses, but you can find its command (<ESC> ^) in Appendix C. All the eight-pin densities and their commands are described in Table 9-1.

Table 9-1. Graphics modes

Mode	Density	Alternate code	Description
0	Single	ESC "K"	60 dots/inch: 480 dots/8" line
1	Low-Speed Double	ESC "L"	120 dots/inch 960 dots/8 line
2	High-Speed Double	ESC "Y"	120 dot positions/inch Faster than Mode 1; does not print consecutive dots in a row.
3	Quadruple	ESC "Z"	240 dot positions/inch; 1920 dot positions/8" line. Does not print consecutive dots in a row.
4	Epson QX-10	none	80 dots/inch; 640 dots/8" line Matches the screen density of the QX-10, which makes it easy to do screen dumps.
5	One-to-one (plotter)	none	72 dots/inch; 576 dots/8" line Produces the same density horizontally as vertically, which makes circles look round.
6	90 dots/line	none	90 dot dots/8" line

You are familiar with the command format that uses the <ESC> code and a letter, but LX-80 graphics commands can also be in the following format:

```
LPRINT CHR$(27)"*"CHR$(M)CHR$(N1)CHR$(N2);
```

with m being the mode number found in the left column of Table 9-1. As usual, n1 and n2 reserve the number of columns for graphics. The seven modes include six densities, with two speeds for double-density.

Reassigning Codes

The LX-80 has a graphics command that changes one graphics mode to another. You can use it with many commercial graphics software programs to change the density and shape of your printouts. The code is <ESC> ?s n, where s is one of the four alternate graphics codes (K, L, Y, or Z) and n is the number of the new code (0–6).

For example, if you send the following code before you run a graphics program, it will change every instance of mode "Y" (high-speed double-density) to mode 5 (one-to-one).

```
LPRINT CHR$(27)"?Y"CHR$(5);
```

As usual, this example is in Microsoft BASIC, but you can send the code in any programming language.

Even if you don't know which code your graphics program uses, a little experimentation should tell you whether the reassigning code can improve your graphics printouts.

WIDTH Statements

Many computer systems automatically insert the control codes for a carriage return and a line feed after every 80 characters. This insertion is usually no problem with text, but it can spoil your graphics. In the graphics mode they may insert the control codes as extra characters, which could be in the middle of a line.

You can usually prevent these unwanted control codes with a WIDTH statement such as the one below:

```
WIDTH LPRINT 255
```

The format for your system may be different. Consult your computer or computer language manual to find the correct format. Then put a WIDTH statement in one of the first lines of all your graphics programs. It is easier to put a WIDTH statement in all but the simplest of your programs than to examine each one to see whether or not such a statement is necessary.

Design Your Own Graphics

This section describes the development of a graphics program. The example is not especially complicated, but it does include the same steps you would use for a more complex figure so that you have the basis for designing graphics on your LX-80.

Plan your figure with dots on graph paper but, before beginning to place the dots, you should decide which graphics density you want. Figure 9-3 shows the differences between the three most-used graphics modes so that you can choose the one you want.

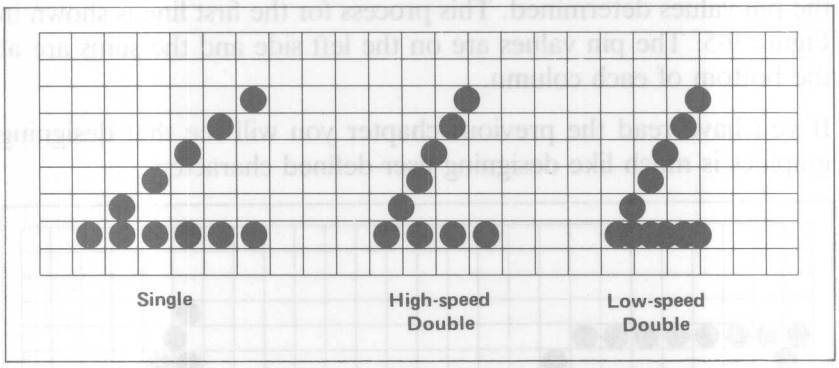


Figure 9-3. Designing in different densities

In this figure you can see the main rules for graphics design in the three densities. In single density, no dots can be placed on vertical lines. In high-speed double density dots can be placed on vertical lines but no dots can overlap. In low-speed double density, dots can be placed on vertical lines and they can overlap.

Now look at the figure designed for high-speed double density. It should point you in the right direction for your own designs.

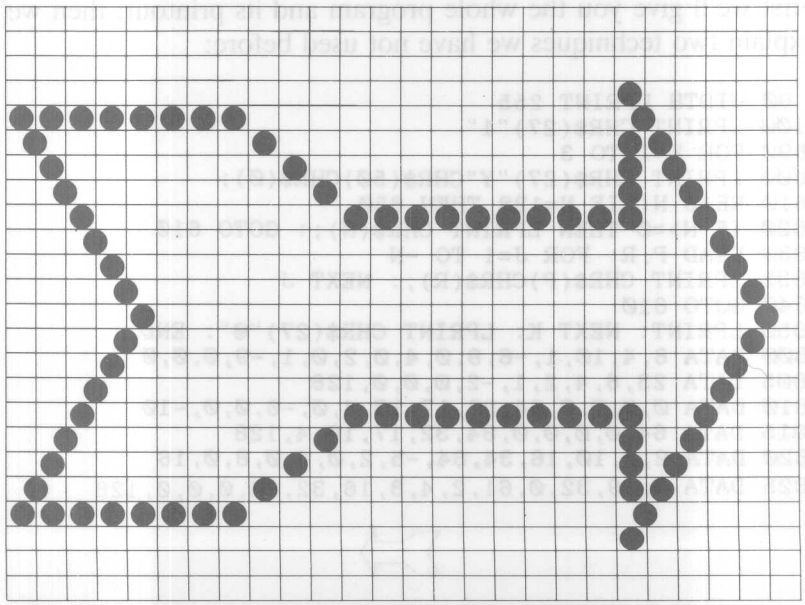


Figure 9-4. Arrow design

After plotting all the dots as in Figure 9-4, calculate the numbers for each pin pattern by dividing the design grid into separate print lines. For the arrow design the grid was divided into three lines, each seven dots high. Then each column was examined and the sums of the pin values determined. This process for the first line is shown in Figure 9-5. The pin values are on the left side and the sums are at the bottom of each column.

If you have read the previous chapter you will see that designing graphics is much like designing user-defined characters.

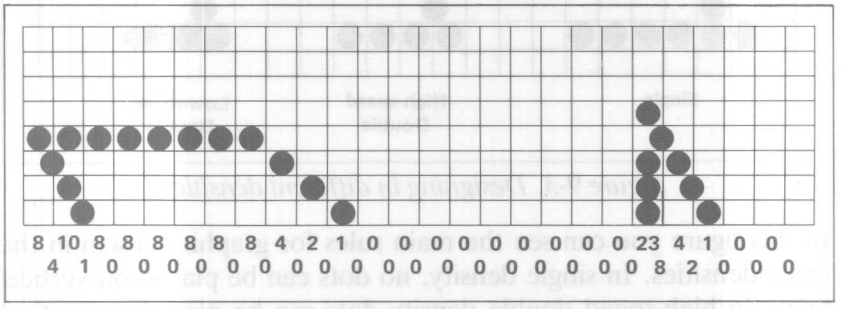


Figure 9-5. First line of arrow figure

The numbers for the second and third lines were calculated in the same manner. Once the numbers for the pin patterns are calculated, they go in DATA statements, separated by commas.

First we'll give you the whole program and its printout; then we'll explain two techniques we have not used before:

```
 9Ø WIDTH LPRINT 255
1ØØ LPRINT CHR$(27)"1"
59Ø FOR K=1 TO 3
6ØØ LPRINT CHR$(27)"Y"CHR$(5Ø)CHR$(Ø);
61Ø READ N: IF N=128 THEN 65Ø
62Ø IF N>=Ø THEN LPRINT CHR$(N);: GOTO 61Ø
63Ø READ P,R: FOR J=1 TO -N
632 LPRINT CHR$(P)CHR$(R);: NEXT J
64Ø GOTO 61Ø
65Ø LPRINT: NEXT K: LPRINT CHR$(27)"@": END
8ØØ DATA 8,4,1Ø,1,-6,8,Ø,4,Ø,2,Ø,1,-9,Ø,Ø,Ø
8Ø5 DATA 23,8,4,2,1,-2,Ø,Ø,Ø,128
81Ø DATA Ø,Ø,Ø,Ø,64,32,17,1Ø,4,Ø,-6,Ø,Ø,-1Ø
815 DATA 64,Ø,Ø,Ø,Ø,64,32,17,1Ø,4,128
82Ø DATA 2,4,1Ø,16,34,64,-5,2,Ø,4,Ø,8,Ø,16
825 DATA Ø,-9,32,Ø,61,2,4,8,16,32,64,Ø,Ø,Ø,128
```

In this program we used the number 128 in the DATA statements to signal the end of a print line. This is the reason for the IF-THEN statement in line 610 that skips to line 650 and causes a line feed.

The other special technique used in this program is found in lines 620 and 630. Since some of the data numbers are repeated many times, negative DATA numbers have been used for repetitions, in order to save typing. Line 620 tests for a negative number and, if it finds one, reads the next two numbers and prints their pin patterns the number of times indicated by the negative number.

For example, when the minus 6 in line 800 is read, the program then reads the next two numbers (8 and 0) and sends them to the printer six times. This feature is not a necessary part of the program, but it does allow you to type fewer data numbers.

Otherwise, the program is a straightforward graphics program that uses 7-dot line spacing and reads numbers from DATA statements and sends them to the printer. If you want to see the figure in other densities, change the "Y" in line 600 to "L" or "Z".

Graphics Programming Tips

Now that we've shown you how to design your own graphics, we'll review and emphasize a few elements of graphics programming. As usual, Microsoft BASIC has been used in the examples, but the principles apply to any programming language although there may be other ways than using a semi-colon to prevent carriage returns and line feeds being added at the end of a statement.

Semicolons and command placement

After the graphics command is issued, every number sent to the LX-80 is interpreted as a pin pattern and printed on paper. Therefore, you must be careful how you write graphics commands in your program.

For example, suppose you want a 50-column graphics line with a 7-dot line spacing. You might enter the following program:

```
20 LPRINT CHR$(27)"K"CHR$(50)CHR$(0)
30 LPRINT CHR$(27)"1"
40 FOR G=1 TO 50: LPRINT CHR$(74): NEXT G
```

This program has all the necessary elements. Line 20 has the command for single-density graphics and specifies 50 columns. (Remember that you must use two numbers to reserve columns even if you only need the first one.) Line 30 has the correct command for the line spacing, and line 40 calls for the printing of a pin pattern 50 times. (If you wish, refer back to Figure 9-2 to see a representation of the pin pattern that 74 produces.)

Although this program has all the necessary elements, it will not give you the single pin pattern that you want, as you can see in the partial printout in Figure 9-6.

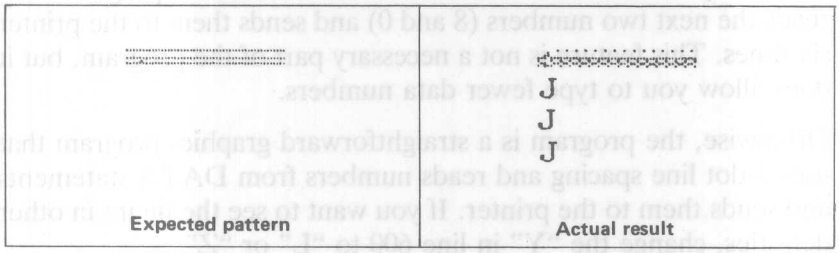


Figure 9-6. Result of incorrect program

What went wrong? To help you understand the graphics command and avoid some of the more common errors made with it, let us examine this program in detail.

First look at line 20. <ESC> K calls for single-density graphics, and the two CHR$ numbers specify 50 columns of dots. Once that command is given, the next 50 codes sent to the printer are interpreted as numbers corresponding to a pin pattern and printed on the paper. Since there is no semi-colon at the end of the line, the numbers 13 and 10—the codes for carriage return and line feed—are sent to the printer after CHR$(0). Because the graphics command has been issued, these codes are printed as pin patterns.

Line 30 would normally be the command for 7-dot line spacing, but since the graphics mode has been put into effect, the command is interpreted by the printer as two pin patterns: 27 and 49 (the ASCII codes for <ESC> and 1). Since there is no semi-colon at the end of this line, the numbers 13 and 10 are sent again, and again they are printed as pin patterns.

In line 40 nothing is sent to the printer until after the LPRINT. Then the desired pin pattern—74—is finally sent, but since no semicolon is after it, 13 and 10 are sent next each time the loop is executed.

Figure 9-7 is an enlarged representation of the first 14 columns of the printout. In this figure you can see exactly how the printer reacted to the first part of the incorrect program.

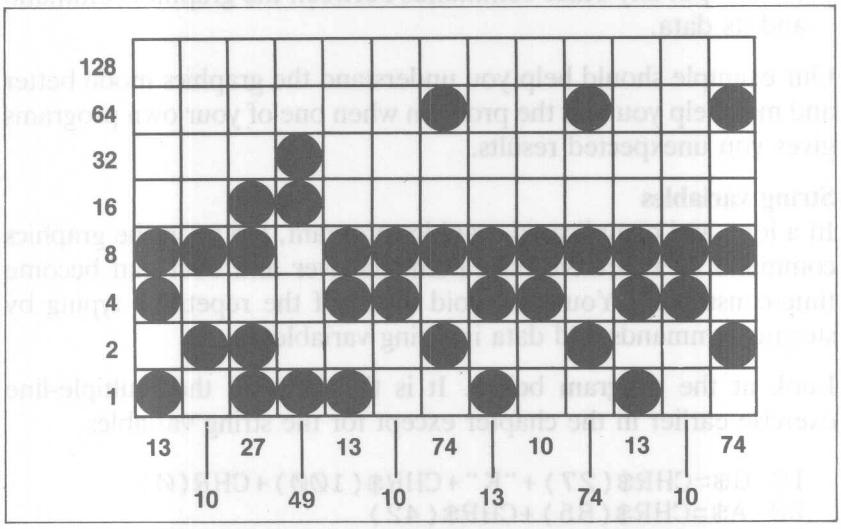


Figure 9-7. Pin patterns of incorrect program

You may also wonder why the program prints not only the different pin patterns but also the character "J" a number of times. The reason lies in the number of columns you reserved with the graphics command. After the LX-80 receives all the numbers reserved by a graphics command—50 in this case—it leaves the graphics mode and resumes interpreting numbers as printable characters or print commands.

Since the incorrect program has sent many extra numbers, mainly 10s and 13s, the 50 columns reserved are filled before the loop in line 40 has been executed 50 times. Therefore, during the last passes of the loop the LX-80 interprets CHR$(74) as the ASCII code for "J" and prints that character each of the last 35 passes of the loop.

If you want to make the program work correctly, put the line-spacing command in line 10, delete line 30 and add two semi-colons: one at the end of line 20 and one between CHR$(74) and the colon in line 40.

This incorrect program has been explained in detail so that you will remember two important tips about using the graphics command:

- Use semi-colons to prevent the LX-80 from printing carriage return and line feed codes as pin patterns in BASIC programs, and take similar steps in other programming languages.
- Do not put any other commands between the graphics command and its data.

Our example should help you understand the graphics mode better and may help you find the problem when one of your own programs gives you unexpected results.

String variables

In a long and complicated graphics program, typing in the graphics command or repetitive data numbers over and over can become time-consuming. You can avoid much of the repetitive typing by storing commands and data in string variables.

Look at the program below. It is the same as the multiple-line exercise earlier in the chapter except for the string variables.

```
10 G$=CHR$(27)+"K"+CHR$(100)+CHR(0)
20 A$=CHR$(85)+CHR$(42)
30 B$=CHR$(42)+CHR$(85)
40 LPRINT CHR$(27)"1";
50 FOR R=1 TO 3
60 LPRINT G$;
70 FOR X=1 TO 50: LPRINT A$;: NEXT X
80 LPRINT
90 LPRINT G$;
100 FOR X=1 TO 50: LPRINT B$;: NEXT X
110 LPRINT: NEXT R
120 LPRINT CHR$(27)"@"
```

Notice that the first line stores the whole graphics command in a single string variable. In order to do this you must put plus signs between the elements of the command. Once you have done this at the beginning of the program, each time you enter LPRINT G$; you have issued the graphics command. Lines 20 and 30 do the same thing with the data used in this program. As you can see, the use of string variables saves some typing even in this short program. In a long program it can save you much more time and effort.

Graphics and low ASCII codes

Sending a few of the codes between 0 and 31 with BASIC or another programming language can cause problems on some computer systems. The problem is that most computer systems handle some of these codes in a special way instead of delivering them to the printer.

For example, one computer system handles form feeds by itself. It counts lines to keep track of the top of page. If a program sends the ASCII code for form feed (12) to the printer, the computer system intercepts it and sends instead the code for line feed (10) several times. If you are in a graphics mode with this system and send a 12 to fire pins 3 and 4, the computer system will intercept that 12 and send several 10s instead. You can see how this would ruin your graphics. You would get pins 2 and 4 (whose sum is 10) several times instead of pins 3 and 4 only once.

If your computer system removes or changes any codes sent to it, you can often design around these problems by using other numbers with similar patterns, and you can see Appendix F for a method to determine which codes may cause problems and for some ideas on overcoming those problems.

Appendix A
ASCII Codes and Character Fonts

This appendix provides information about the way ASCII codes are used on the LX-80 printer and about the character fonts associated with those codes. The following page shows the characters corresponding to the codes. The numerical value is given both in decimal and hexadecimal. The column marked CHR shows the character printed by the LX-80. Some codes are control codes which have names in the ASCII standard. All of these names are included in this Appendix so that if you have a computer manual or a software manual referring to them you can see to which code they correspond. Following that is a table which shows which control codes actually function in the LX-80. Since many software packages require that you input control characters by pressing the CONTROL or CTRL key on your keyboard together with another key, a table is also included to show you which keys to press. Finally there is a section which displays the special graphics characters as enlarged dot matrices so that you can see how they are formed if you wish to design some of your own.

Sending printer codes is discussed in Chapter 4, and the method of printing the special graphics and international characters is discussed in Chapter 6.

Dec	Hex	CHR	Dec	Hex	CHR	Dec	Hex	CHR	Dec	Hex	CHR
0	00	NUL	64	40	@	128	80	Ç	192	C0	À
1	01	SOH	65	41	A	129	81	ü	193	C1	Á
2	02	STX	66	42	B	130	82	é	194	C2	Â
3	03	ETX	67	43	C	131	83	â	195	C3	Ã
4	04	EOT	68	44	D	132	84	ä	196	C4	Ä
5	05	ENQ	69	45	E	133	85	à	197	C5	Å
6	06	ACK	70	46	F	134	86	å	198	C6	Æ
7	07	BEL	71	47	G	135	87	ç	199	C7	Ç
8	08	BS	72	48	H	136	88	ê	200	C8	È
9	09	HT	73	49	I	137	89	ë	201	C9	É
10	0A	LF	74	4A	J	138	8A	è	202	CA	Ê
11	0B	VT	75	4B	K	139	8B	ï	203	CB	Ë
12	0C	FF	76	4C	L	140	8C	î	204	CC	Ì
13	0D	CR	77	4D	M	141	8D	ì	205	CD	Í
14	0E	SO	78	4E	N	142	8E	Ä	206	CE	Î
15	0F	SI	79	4F	O	143	8F	Å	207	CF	Ï
16	10	DLE	80	50	P	144	90	É	208	D0	Ð
17	11	DC1	81	51	Q	145	91	æ	209	D1	Ñ
18	12	DC2	82	52	R	146	92	Æ	210	D2	Ò
19	13	DC3	83	53	S	147	93	ô	211	D3	Ó
20	14	DC4	84	54	T	148	94	ö	212	D4	Ô
21	15	NAK	85	55	U	149	95	ò	213	D5	Õ
22	16	SYN	86	56	V	150	96	û	214	D6	Ö
23	17	ETB	87	57	W	151	97	ù	215	D7	×
24	18	CAN	88	58	X	152	98	ÿ	216	D8	Ø
25	19	EM	89	59	Y	153	99	Ö	217	D9	Ù
26	1A	none	90	5A	Z	154	9A	Ü	218	DA	Ú
27	1B	ESC	91	5B	[	155	9B	¢	219	DB	Û
28	1C	none	92	5C	\	156	9C	£	220	DC	Ü
29	1D	none	93	5D	]	157	9D	¥	221	DD	Ý
30	1E	none	94	5E	^	158	9E	₧	222	DE	Þ
31	1F	none	95	5F	_	159	9F	ƒ	223	DF	ß
32	20		96	60	`	160	A0	á	224	E0	à
33	21	!	97	61	a	161	A1	í	225	E1	á
34	22	"	98	62	b	162	A2	ó	226	E2	â
35	23	#	99	63	c	163	A3	ú	227	E3	ã
36	24	$	100	64	d	164	A4	ñ	228	E4	ä
37	25	%	101	65	e	165	A5	Ñ	229	E5	å
38	26	&	102	66	f	166	A6	ª	230	E6	æ
39	27	'	103	67	g	167	A7	º	231	E7	ç
40	28	(	104	68	h	168	A8	¿	232	E8	è
41	29	)	105	69	i	169	A9	⌐	233	E9	é
42	2A	*	106	6A	j	170	AA	¬	234	EA	ê
43	2B	+	107	6B	k	171	AB	½	235	EB	ë
44	2C	,	108	6C	l	172	AC	¼	236	EC	ì
45	2D	-	109	6D	m	173	AD	¡	237	ED	í
46	2E	.	110	6E	n	174	AE	«	238	EE	î
47	2F	/	111	6F	o	175	AF	»	239	EF	ï
48	30	0	112	70	p	176	B0	▒	240	F0	ð
49	31	1	113	71	q	177	B1	▒	241	F1	ñ
50	32	2	114	72	r	178	B2	▒	242	F2	ò
51	33	3	115	73	s	179	B3	▒	243	F3	ó
52	34	4	116	74	t	180	B4	▒	244	F4	ô
53	35	5	117	75	u	181	B5	▒	245	F5	õ
54	36	6	118	76	v	182	B6	▒	246	F6	ö
55	37	7	119	77	w	183	B7	▒	247	F7	÷
56	38	8	120	78	x	184	B8	▒	248	F8	ø
57	39	9	121	79	y	185	B9	▒	249	F9	ù
58	3A	:	122	7A	z	186	BA	▒	250	FA	ú
59	3B	;	123	7B	{	187	BB	▒	251	FB	û
60	3C	<	124	7C	|	188	BC	▒	252	FC	ü
61	3D	=	125	7D	}	189	BD	▒	253	FD	ý
62	3E	>	126	7E	~	190	BE	▒	254	FE	~
63	3F	?	127	7F	DEL	191	BF	▒	255	FF	

Control Codes Used by the LX-80

The following table shows which control codes are used by the LX-80. If the special graphics character set is not used, codes in the range 128 to 155 mirror the function of their low-order counterparts, i.e. codes in the range 0 to 27 . In some cases it is necessary or more convenient to use the high-order codes instead of the low-order ones. For example, if your system will not send an ASCII code 9 for a horizontal tab, try sending ASCII code 137 instead. Both sets are listed here:

Low Dec	High Dec	High Hex	Symbol	Function
0	128	80	NUL	Terminates horizontal and vertical tab setting <ESC> sequence
7	135	87	BEL	Sounds beeper
8	136	88	BS	Backspace
9	137	89	HT	Horizontal tab
10	138	8A	LF	Line feed
11	139	8B	VT	Vertical tab
12	140	8C	FF	Form feed
13	141	8D	CR	Carriage return
14	142	8E	SO	Shift out; turns expanded mode ON
15	143	8F	SI	Shift in; turns condensed mode ON
18	146	92	DC2	Device control 2; turns condensed mode OFF
20	148	93	DC4	Device control 4; turns expanded mode set by ASCII 14 OFF
24	152	97	CAN	Cancels all text in print buffer
25	153	98	EM	Used with <ESC> code to enable/disable cut-sheet feeder
27	155	9B	ESC	<ESC> code

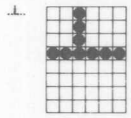
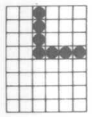
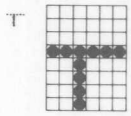
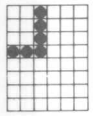
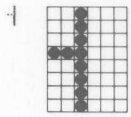
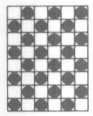
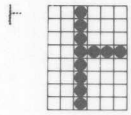
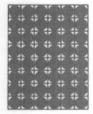
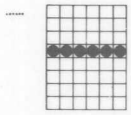
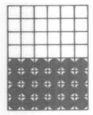
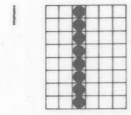
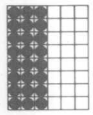
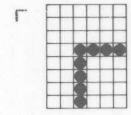
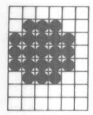
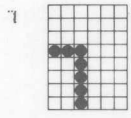
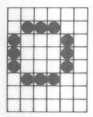
Note: The high-order control codes cannot be used if the special graphics characters are activated.

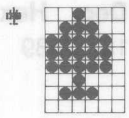
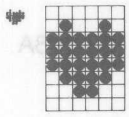
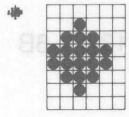
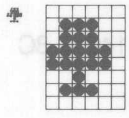
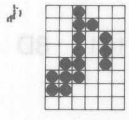
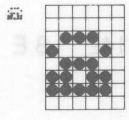
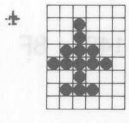
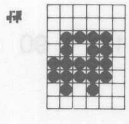
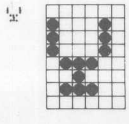
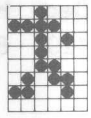
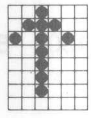
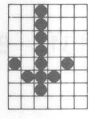
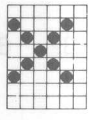
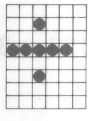
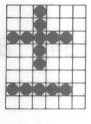
ing to decimal values 0–27. The table below shows which keys to hold down for which code. The Control key column indicates that you press the control key at the same time as you press the key for the letter or symbol in that column. For example, you press the control key and A at the same time to send the ASCII code 1.

Some programs that use this system cannot use Control-@, and many programs use the control keys for their own distinctly different purpose.

Decimal	Hexadecimal	Control key
0	00	@
1	01	A
2	02	B
3	03	C
4	04	D
5	05	E
6	06	F
7	07	G
8	08	H
9	09	I
10	0A	J
11	0B	K
12	0C	L
13	0D	M
14	0E	N
15	0F	O
16	10	P
17	11	Q
18	12	R
19	13	S
20	14	T
21	15	U
22	16	V
23	17	W
24	18	X
25	19	Y
26	1A	Z

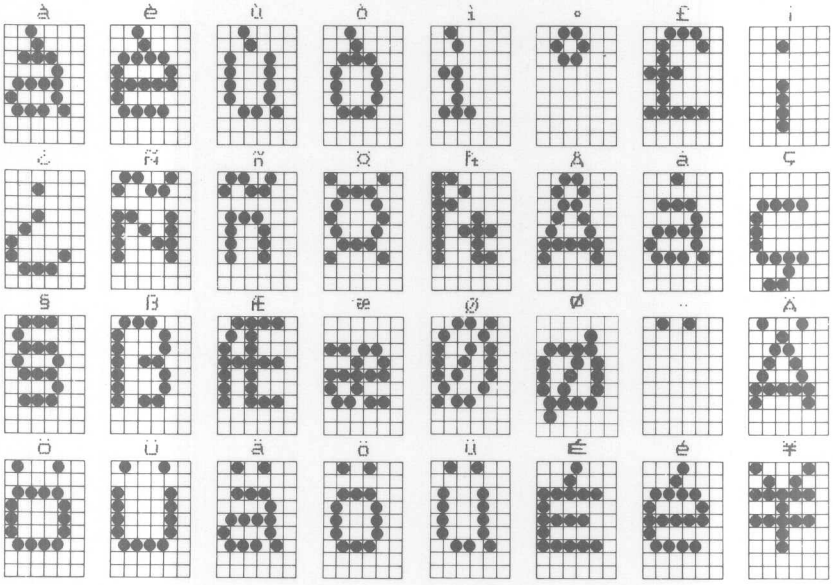
Special Graphics Characters

Dec	Hex	Character	Dec	Hex	Character
129	81		137	89	
130	82		138	8A	
131	83		139	8B	
132	84		140	8C	
133	85		141	8D	
134	86		142	8 E	
135	87		143	8F	
136	88		144	90	

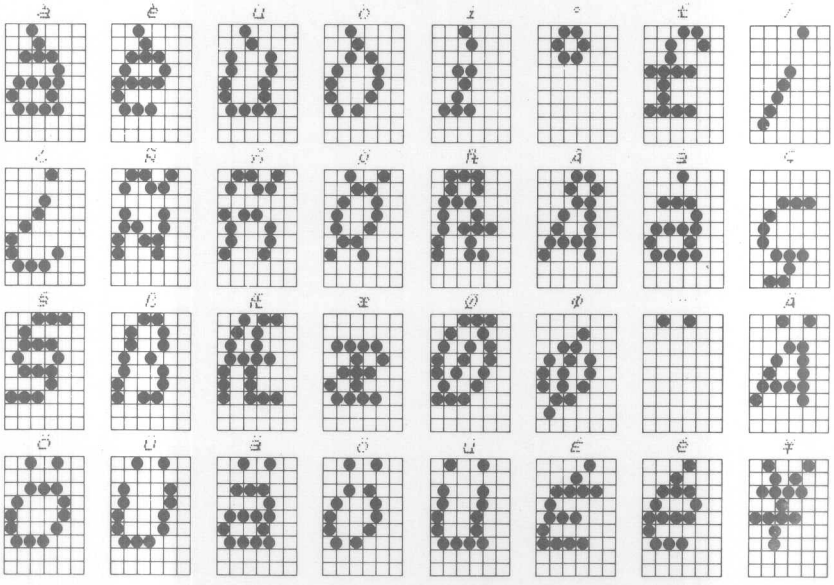
Dec	Hex	Character
145	91	
146	92	
147	93	
148	94	
149	95	
150	96	
151	97	
152	98	
153	9A	
154	9B	
155	9C	
156	9C	
157	9D	
158	9E	
159	9F	

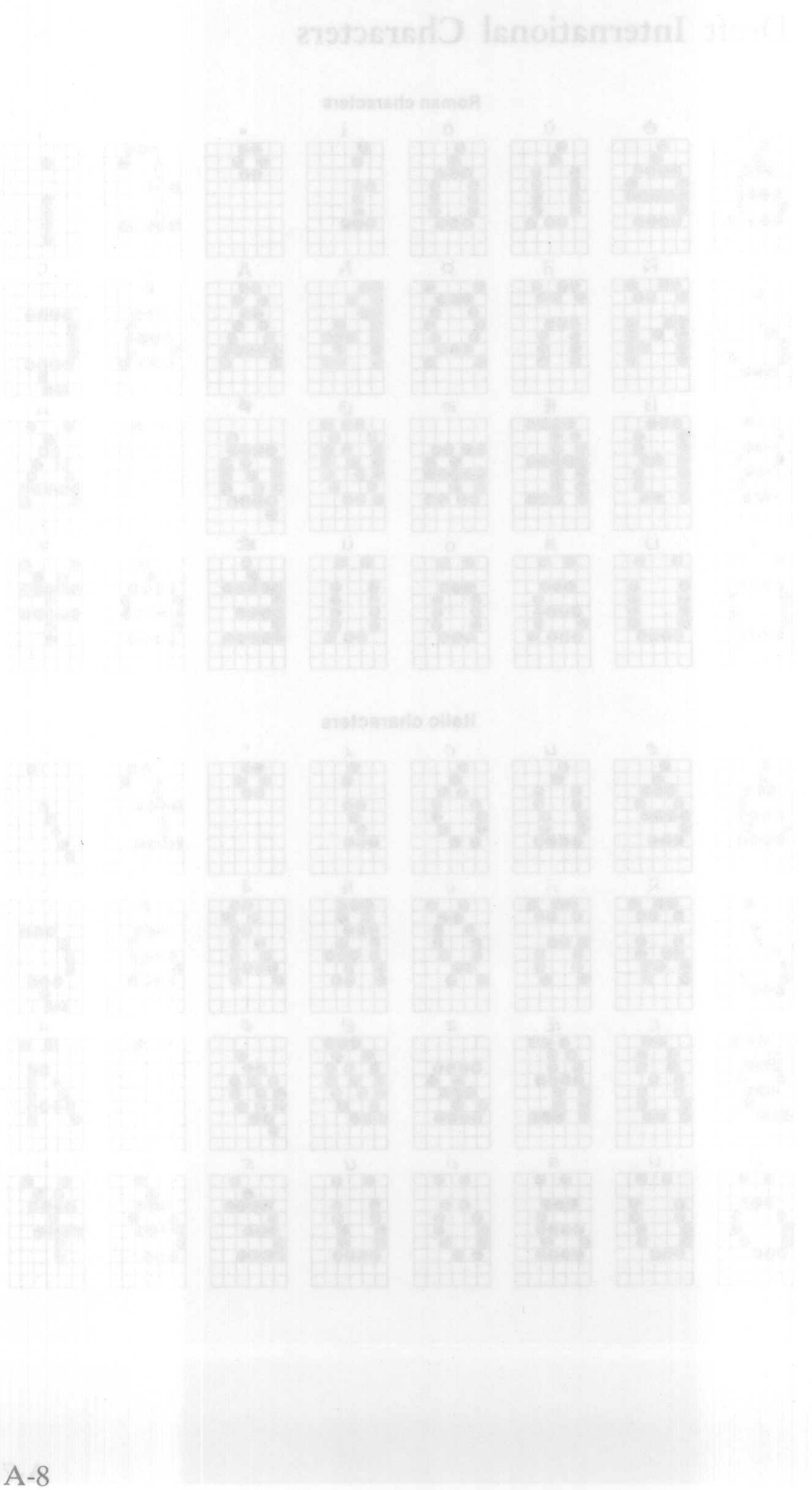
Draft International Characters

Roman characters



Italic characters





Appendix B
Software Commands in Numerical Order

The following list shows the control codes and <ESC> sequences which the LX-80 uses. For further details on their use, consult the index to find out where they may be discussed in the text, or Appendix C for details of the correct syntax for their use.

	7	BEL	Sounds buzzer
	8	BS	Backspace
	9	HT	Executes horizontal TAB
	10	LF	Line feed
	11	VT	Executes vertical TAB
	12	FF	Form feed
	13	CR	Carriage return
	14	SO	Enlarged print (one line)
	15	SI	Condensed pitch
	18	DC2	Cancels condensed mode
	20	DC4	Cancels enlarged print
	24	CAN	Cancels data in the print buffer
ESC	14	SO	Same as SO
ESC	15	SI	Same as SI
ESC	25	ESC EM	Cut sheet feeder mode
ESC	33	ESC !	Selects print mode
ESC	37	ESC %	Selects ROM/RAM character set
ESC	38	ESC &	Defines downloaded character
ESC	42	ESC *	Bit-image select
ESC	45	ESC -	Underline
ESC	47	ESC /	Selects vertical tab format
ESC	48	ESC 0	1/8 inch line spacing
ESC	49	ESC 1	7/72 inch line spacing
ESC	50	ESC 2	1/6 inch line spacing
ESC	51	ESC 3	n/216 inch line spacing
ESC	52	ESC 4	Italic print
ESC	53	ESC 5	Cancels italic print
ESC	56	ESC 8	Paper end detector—OFF
ESC	57	ESC 9	Paper end detector—ON
ESC	58	ESC :	Copy ROM character set into RAM
ESC	60	ESC <	Unidirectional print (one line)
ESC	63	ESC ?	Redefines bit-image modes
ESC	64	ESC @	Initializes the printer
ESC	65	ESC A	n/72 inch line spacing
ESC	66	ESC B	Sets vertical TAB

ESC	67	ESC C	Form length
ESC	68	ESC D	Sets horizontal TAB
ESC	69	ESC E	Emphasized print
ESC	70	ESC F	Cancels emphasized print
ESC	71	ESC G	Double-strike print
ESC	72	ESC H	Cancels double-strike print
ESC	74	ESC J	n/216 inch line feed
ESC	75	ESC K	Normal-density bit-image
ESC	76	ESC L	Dual-density bit-image
ESC	77	ESC M	Elite pitch
ESC	78	ESC N	Sets bottom margin
ESC	79	ESC O	Cancels bottom margin setting
ESC	80	ESC P	Pica pitch
ESC	81	ESC Q	Sets right margin
ESC	82	ESC R	Selects character set
ESC	83	ESC S	Super/subscript
ESC	84	ESC T	Cancels super/subscript
ESC	85	ESC U	Unidirectional printing
ESC	87	ESC W	Enlarged print
ESC	89	ESC Y	Double-speed, double-density bit-image
ESC	90	ESC Z	Quadruple-density bit-image
ESC	94	ESC ^	9-pin bit-image
ESC	97	ESC a	Sets format justification
ESC	98	ESC b	Presets vertical format
ESC	101	ESC e	Horizontal/vertical TAB
ESC	102	ESC f	Paper feed/TAB execute
ESC	108	ESC l	Sets left margin
ESC	109	ESC m	Special character generator
ESC	115	ESC s	Half speed printing
ESC	120	ESC x	Selects draft/NLQ mode
	127	DEL	Cancels last character

Appendix C

Command Summary

This appendix gives an outline of the LX-80 commands.

The commands are divided up into groups with an introduction to their use. Each command then shows:

Code Sequence and Function

Format:	The symbol or sequence to be used with the printer. Where numerical data is to be added, the ASCII code corresponding to the number is added to the code as described in the main text. In this case it is denoted by the symbol (n) or a similar symbol.
ASCII code:	The letter or character in the ASCII table. A term such as (n), (c), or (m) denotes a variable ASCII code. The values of the variable are given in the explanation.
Decimal:	The decimal value of that code.
Hexadecimal:	The hexadecimal value mainly for machine code use.
Explanation:	An abbreviated description of the effect of issuing the command.
Control:	The key that must be pressed with CTRL to obtain the code. (Ctrl E is not the same code as Ctrl e.) If Ctrl is not specified use the upper or lower case letter exactly as shown.

Contents

C.1 Near Letter Quality Mode

ESC x (n) — Select Print Mode

Format:

ASCII code:	<ESC>	x	(n)
Decimal:	27	120	(n)
Hexadecimal:	1B	78	(n)

Explanation:

Selects draft mode if n = 0 or Near Letter Quality (NLQ) mode if n = 1.

ESC a — Select Justification Mode

Format:

ASCII code:	<ESC>	a	(n)
Decimal:	27	97	(n)
Hexadecimal:	1B	61	(n)

Explanation:

See Chapter 7 for the use and control of justification.

C.2 Character Width (Pitch)

SI — Set Condensed Characters

Format:

ASCII code:	<SI>
Decimal:	15
Hexadecimal:	0F
Control:	Ctrl O

Explanation:

This command is only effective in draft mode. It produces characters which are half the width of the normal draft characters.

ESC SI — Set Condensed Characters

Format:

ASCII code:	<ESC>	<SI>
Decimal:	27	15
Hexadecimal:	1B	0F

Explanation:

Duplicates the <SI> command.

DC2 — Cancel Condensed Print

Format:

ASCII code:	<DC2>
Decimal:	18
Hexadecimal:	12
Control:	Ctrl R

Explanation:

This command cancels the condensed printing set by <SI> and <ESC> <SI>.

SO — Set Enlarged Characters (one line)

Format:

ASCII code:	**<SO>**
Decimal:	**14**
Hexadecimal:	**0E**
Control:	**Ctrl N**

Explanation:

This command sets the characters to twice the width of the normal characters. It is cancelled by a carriage return unless deliberately cancelled sooner by <DC4>.

ESC SO — Set Enlarged Characters (one line)

Format:

ASCII code:	**<ESC>**	**<SO>**
Decimal:	**27**	**14**
Hexadecimal:	**1B**	**0E**

Explanation:

Duplicates the <SO> command.

DC4 — Cancel Enlarged Characters (one line)

Format:

ASCII code:	**<DC4>**
Decimal:	**20**
Hexadecimal:	**14**
Control:	**Ctrl T**

Explanation:

Cancels the one-line enlarged printing set by <SO> or <ESC> <SO>, but not the enlarged printing set by <ESC> W or <ESC> !.

ESC W (n) — Select Enlarged Characters

Format:

ASCII code:	<ESC>	W	(n)
Decimal:	27	87	(n)
Hexadecimal:	1B	57	(n)

Explanation:

This command turns enlarged characters on (when n = 1) until switched off (when n = 0).

ESC M — Select Elite Pitch

Format:

ASCII code:	<ESC>	M
Decimal:	27	77
Hexadecimal:	1B	4D

Explanation:

Selects elite pitch (12 characters per inch).

ESC P — Select Pica Pitch

Format:

ASCII code:	<ESC>	P
Decimal:	27	80
Hexadecimal:	1B	50

Explanation:

Selects pica pitch (10 characters per inch). This is the default character width and so this command is normally used to cancel the elite pitch.

C.3 Character Weight

ESC E — Set Emphasized Print

Format:

ASCII code:	<ESC>	E
Decimal:	27	69
Hexadecimal:	1B	45

Explanation:

This command produces a more intense character at a reduced speed by printing the character a second time at a position slightly shifted along the line. It may be used in conjunction with double strike mode.

ESC F — Cancel Emphasized Print

Format:

ASCII code:	<ESC>	F
Decimal:	27	70
Hexadecimal:	1B	46

Explanation:

Turns off the emphasized mode set by <ESC> E.

ESC G — Set Double-Strike Mode

Format:

ASCII code:	<ESC>	G
Decimal:	27	71
Hexadecimal:	1B	47

Explanation:

Causes the character to be printed twice thus making the character bolder. It may be used in conjunction with emphasized print. It causes the printer speed to reduce because it is printing twice.

ESC H — Cancel Double-Strike Mode

Format:

ASCII code:	<ESC>	H
Decimal:	27	72
Hexadecimal:	1B	47

Explanation:

Turns off double-strike mode set by <ESC> G.

C.4 Print Enhancement

ESC S (n) — Set Superscript/Subscript

Format:

ASCII code:	<ESC>	S	(n)
Decimal:	27	83	(n)
Hexadecimal:	1B	53	(n)

Explanation:

This command either selects superscript (when n = 0) or subscript (when n = 1).

ESC T — Cancel Superscript/Subscript

Format:

ASCII code:	<ESC>	T
Decimal:	27	84
Hexadecimal:	1B	54

Explanation:

Turns off either superscript or subscript.

ESC – — Select Underlining

Format:

ASCII code:	<ESC>	–	(n)
Decimal:	27	45	(n)
Hexadecimal:	1B	2D	(n)

Explanation:

When the value of n = 1, underlining is turned on, when n = 0, underlining is turned off.

C.5 Mode and Character Set Selection

DC3 — Deselect Printer

Format:

ASCII code:	<DC3>
Decimal:	19
Hexadecimal:	13
Control:	Ctrl S

Explanation:

Places the printer in off-line mode until the select printer code <DC1> is received.

DC1 — Select Printer

Format:

ASCII code:	<DC1>
Decimal:	17
Hexadecimal:	11
Control:	Ctrl Q

Explanation:

Returns the printer to the on-line mode if it has been switched off by the printer deselect code <DC3>. It will not switch the printer on-line if it has been switched off using the ON LINE switch on the control panel.

ESC ! (n) — Select Master Style

Format:

ASCII code:	<ESC>	!	(n)
Decimal:	27	33	(n)
Hexadecimal:	1B	21	(n)

Explanation:

This command enables a number of commands to be added together, for example pica plus double strike plus emphasized plus italic plus expanded plus underlined. The value of n determines the combination to be used. Full details of the values and examples are given in Chapter 6 and Appendix B.

ESC 4 — Set Italic Characters

Format:

ASCII code:	<ESC>	4
Decimal:	27	52
Hexadecimal:	1B	34

Explanation:

This command causes characters to be printed using the italic character set. The italic characters can also be obtained if a code with the eighth bit set is sent to the printer.

ESC 5 — Cancel Italic Characters

Format:

ASCII code:	<ESC>	5
Decimal:	27	53
Hexadecimal:	1B	35

Explanation:

Cancels the italic printing set by <ESC> 4.

ESC @ — Initialize Printer

Format:

ASCII code:	<ESC>	@
Decimal:	27	64
Hexadecimal:	1B	40

Explanation:

Resets the printer to the power-on state, including top of form. Clears the buffer of all data entered before the command but not after.

ESC R — Select International Character Set

Format:

ASCII code:	<ESC>	R	(n)
Decimal:	27	82	(n)
Hexadecimal:	1B	52	(n)

Explanation:

Some character codes produce different characters for different countries. The characters are outlined in Chapter 6. The value of n determines which character set is printed. The countries corresponding to the values of n are:

n	Country	n	Country
0	USA	6	Italy
1	France	7	Spain
2	Germany	8	Japan
3	United Kingdom	9	Norway
4	Denmark I	10	Denmark II
5	Sweden		

ESC m — Set Special Character Generator

Format:

ASCII code:	<ESC>	m
Decimal:	27	109
Hexadecimal:	1B	6D

Explanation:

This code allows ASCII codes 128 to 159 to print special graphics characters. See Chapter 6 for details.

C.6 Special Printer Features

BS — Backspace

Format:

ASCII code:	<BS>
Decimal:	8
Hexadecimal:	08
Control:	Ctrl H

Explanation:

The print head is moved one space to the left. This allows the characters to be printed on top of one another. The two characters are printed together without an actual backspace movement taking place. The character is ignored when the carriage is at the left of the printer, or if the printer is in bit image mode.

ESC <EM> (n) — Cut Sheet Feeder Control

Format:

ASCII code:	<ESC>	<EM>	(n)
Decimal:	27	25	(n)
Hexadecimal:	1B	19	(n)
Control:	Ctrl [	Ctrl Y	(n)

Explanation:

This command is used with the optional cut-sheet feeder. When n = 0 the feeder is turned off, when n = 4 it is turned on. Using DIP Switch 1-3 produces the same effect.

ESC < Set Unidirectional Mode (one line)

Format:

ASCII code:	<ESC>	<
Decimal:	27	60
Hexadecimal:	1B	3C

Explanation:

Sets unidirectional printing for more accurate positioning during text printing for one line only. It is cancelled by a carriage return. (Bit image printing is always unidirectional.)

ESC U Set Unidirectional Mode

Format:

ASCII code:	<ESC>	U	(n)
Decimal:	27	85	(n)
Hexadecimal:	1B	55	(n)

Explanation:

Sets unidirectional printing for more accurate positioning during text printing. If n = 1 unidirectional mode is enabled while n = 0 disables the feature. (Bit image printing is always unidirectional.)

ESC s Select Half Speed Mode

Format:

ASCII code:	<ESC>	s	(n)
Decimal:	27	115	(n)
Hexadecimal:	1B	73	(n)

Explanation:

Selects half speed printing if n = 1 or returns to full speed if n = 0.

C.7 Line Spacing

LF — Line Feed

Format:

ASCII code:	<LF>	
Decimal:	10	
Hexadecimal:	0A	
Control:	Ctrl J	

Explanation:

When this command is given, the data in the print buffer is printed and the paper advances one line according to the current line spacing.

ESC 0 — Set 1/8 Inch Line Spacing

Format:

ASCII code:	<ESC>	0
Decimal:	27	48
Hexadecimal:	1B	30

Explanation:

Sets the line spacing to 1/8 of an inch (22 dots) for subsequent line feed commands. The "0" is the digit zero and not the character with ASCII code 0.

ESC 1 — Set 7/72 Inch Line Spacing

Format:

ASCII code:	<ESC>	1
Decimal:	27	49
Hexadecimal:	1B	31

Explanation:

Sets the line spacing to 7/72 of an inch (18 dots) for subsequent line feed commands. The "1" is the digit one and not lower case L.

ESC 2 — Set 1/6 Inch Line Spacing

Format:

ASCII code:	<ESC>	2
Decimal:	27	50
Hexadecimal:	1B	32

Explanation:

Sets the line spacing to 1/6 of an inch (30 dots) for subsequent line feed commands. The "2" is the digit two and not the character with ASCII code 2. This is the default at power on.

ESC 3 (n) — Set n/180 Inch Line Spacing

Format:

ASCII code:	<ESC>	3	(n)
Decimal:	27	51	(n)
Hexadecimal:	13	33	(n)

Explanation:

Sets the line spacing to n/216 of an inch (n dots) for subsequent <LF> commands. The "3" is the digit three and not the character with ASCII code 3. The vertical spacing of the dots on the LX-80 is 1/216 of an inch. The value of n should be in the range 0 to 255.

ESC J — n/180 Inch Line Feed for One Line

Format:

ASCII code:	<ESC>	J	(n)
Decimal:	27	74	(n)
Hexadecimal:	1B	4A	(n)

Explanation:

Advances the paper by one line at a spacing of n/216 of an inch (n dots). The value of n should be in the range 0 to 255. This command does not send a carriage return with the line feed.

ESC A (n) — Set n/60 Inch Line Spacing

Format:

ASCII code:	<ESC>	A	(n)
Decimal:	27	65	(n)
Hexadecimal:	1B	41	(n)

Explanation:

Sets the line spacing to n/60 of an inch (n×3 dots) for subsequent line feed commands. The vertical spacing of the dots on the LX-80 is 1/180 of an inch. The value of n should be in the range 0 to 85.

C.8 Forms Control

FF — Form Feed

Format:

ASCII code:	<FF>
Decimal:	11
Hexadecimal:	0C
Control:	Ctrl L

Explanation:

When this command is given, the data in the print buffer is printed and the paper advances to the top of the next page according to the current page length.

ESC 8 — Disable Paper-Out Sensor

Format:

ASCII code:	<ESC>	8
Decimal:	27	56
Hexadecimal:	1B	38

Explanation:

Turns off the paper sensor so that you can print right to the base of a single sheet of paper. This command temporarily duplicates the function of DIP switch SW1-2.

ESC 9 — Enable Paper-Out Sensor

Format:

ASCII code:	<ESC>	9
Decimal:	27	57
Hexadecimal:	1B	39

Explanation:

Turns on paper-out sensor so that the printer buzzer sounds when the printer runs out of paper.

ESC C — Set Page Length in Lines

Format:

ASCII code:	<ESC>	C	(n)
Decimal:	27	67	(n)
Hexadecimal:	1B	43	(n)

Explanation:

Sets the page length to n lines. The value of n should be in the range 1 to 127.

ESC C <NUL> (n) — Set Page Length in Inches

Format:

ASCII code:	<ESC>	C	<NUL>	(n)
Decimal:	27	67	0	(n)
Hexadecimal:	1B	43	00	(n)
Control:	Ctrl [	C	Ctrl @	(n)

Explanation:

Sets the page length to n inches where n has a value of 1 to 22.

ESC N — Set Skip Over Perforation

Format:

ASCII code:	<ESC>	N	(n)
Decimal:	27	78	(n)
Hexadecimal:	1B	4E	(n)

Explanation:

Sets a margin at the bottom of the page. Apart from the ability to set the margin, this command is useful to prevent printing over the perforations on fanfold paper.

ESC O — Cancel Skip Over Perforation

Format:

ASCII code:	<ESC>	O
Decimal:	27	79
Hexadecimal:	1B	4F

Explanation:

The bottom margin is set to zero lines. This means printing will continue to print over the perforation when printing a listing, for example, when no counting of the lines is being carried out by the computer.

C.9 Page Format

ESC B (n1) (n2) (0) — Set Vertical Tabs

Format:

ASCII code:	<ESC>	B	(n1)	(n2)	...	<NUL>
Decimal:	27	66	(n1)	(n2)	...	0
Hexadecimal:	1B	42	(n1)	(n2)	...	00

Explanation:

This command allows setting of up to 16 vertical tabs. The tabs can be set in 8 channels using the <ESC> b command. This command sets the tabs in channel 0. These are entered as n1, n2, n3 etc (in the range 1 to 254) with the <NUL> character as the terminator. The tab settings n1, n2, n3 etc must be entered in ascending order. The tab settings can be cleared by executing the command giving a value of zero to n1. Altering the line spacing after giving this command does not affect the absolute position of the tab setting.

ESC b (c) (n1) (n2) (0) — Set Vertical Tabs in Channels

Format:

ASCII code:	<ESC>	b	(c)	(n1)	(n2)	...	<NUL>
Decimal:	27	66	(c)	(n1)	(n2)	...	0
Hexadecimal:	1B	42	(c)	(n1)	(n2)	...	00

Explanation:

This command allows setting of up to 16 vertical tabs. The tabs can be set in 8 channels (the range of c is 0 to 8). The channel set by <ESC> b is channel 0. These are entered as n1, n2, n3 etc (in the range 1 to 254) with the <NUL> character as the terminator. The tab settings n1, n2, n3 etc must be entered in ascending order. The tab settings can be cleared by executing the command giving a value of zero to n1. Altering the line spacing after giving this command does not affect the absolute position of the tab setting.

ESC / (c) — Select Vertical Tab Channel

Format:

ASCII code:	<ESC>	/	(c)
Decimal:	27	47	(c)
Hexadecimal:	13	2F	(c)

Explanation:

This command is used to set the vertical tab channel, where c has the value 0 to 6.

VT — Tab Vertically

Format:

ASCII code:	<VT>
Decimal:	11
Hexadecimal:	0B
Control:	Ctrl K

Explanation:

Advances the paper to the next tab setting in the channel selected by <ESC> / c. If no channel has been set, channnel 0 is used. If no vertical tabs have been set, the paper advances one line.

HT — Tab Horizontally

Format:

ASCII code:	<HT>
Decimal:	9
Hexadecimal:	9
Control:	Ctrl I

Explanation:

When this command is given the print head is advanced to the next horizontal tab setting.

ESC D (n1) (n2) (0) — Set Horizontal Tabs

Format:

ASCII code:	<ESC>	D	(n1)	(n2)	...	<NUL>
Decimal:	27	68	(n1)	(n2)	...	0
Hexadecimal:	1B	44	(n1)	(n2)	...	00

Explanation:

This command allows setting of up to 32 horizontal tabs. These are entered as n1, n2, n3 etc (in the range 1 to 137) with the <NUL> character as the terminator. The tab settings n1, n2, n3 etc must be entered in ascending order. The tab settings can be cleared by executing the command with n1 set to zero. The settings on power up or after an <ESC> @ command are every eight characters.

ESC e — Set Tab Increments

Format:

ASCII code:	<ESC>	e	(n)	(s)
Decimal:	27	101	(n)	(s)
Hexadecimal:	1B	65	(n)	(s)

Explanation:

This command sets the horizontal or vertical tab increments. When n is 0 the horizontal tabs are set at intervals of s spaces. Maximum values are 21 in pica, 25 in elite and 36 in compressed text modes. When n is 1 the vertical tabs are set to s line feeds where the line spacing is as defined in C.7 above.

ESC f — Horizontal/Vertical Skip

Format:

ASCII code:	<ESC>	f	(n)	(s)
Decimal:	27	102	(n)	(s)
Hexadecimal:	1B	66	(n)	(s)

Explanation:

Prints spaces or line feeds without carriage returns. When n is 0 s spaces will be inserted up to a maximum of 127. If n is set to 1 s line feeds will be performed

ESC Q — Set Right Margin

Format:

ASCII code:	<ESC>	Q	(n)
Decimal:	27	81	(n)
Hexadecimal:	1B	51	(n)

Explanation:

This command must be given at the beginning of the line. The data in the print buffer is lost and the right margin is set to n columns of the current character width. When the right margin is reached, a carriage return and line feed is added to the characters being printed.

ESC l — Set Left Margin

Format:

ASCII code:	<ESC>	l	(n)
Decimal:	27	108	(n)
Hexadecimal:	1B	6C	(n)

Explanation:

The character "l" is a lower case "L" as in "hello". This command should be placed at the beginning of a line. The data in the print buffer is lost and the left margin is set to n columns of the current character width. The value of n should be in the range 0 to 160, but will be ignored if the setting would give a margin of more than 8 inches.

C.10 User-Defined Characters

ESC : Copy ROM Into User-Defined Characters

Format:

ASCII code:	<ESC>	:	<NUL>	<NUL>	<NUL>
Decimal:	27	58	0	0	0
Hexadecimal:	1B	3A	00	00	00

Explanation:

This code allows the characters in the LX-80 ROM to be copied into the user-defined character set so that specific characters can be redefined. Select the mode to be used (draft or Near Letter Quality as required) to ensure the correct set is copied.

ESC & Define User-Defined Characters

Format:

ASCII code:	<ESC>	&	<NUL>	(data1) (data2) ... (data n)
Decimal:	27	38	0	(data1) (data2) ... (data n)
Hexadecimal:	1B	26	00	(data1) (data2) ... (data n)

Explanation:

This command allows characters to be re-defined in the currently selected mode. The mode to be used must be selected before down-loading the character(s). Chapter 8 gives an outline of the method used and the significance of the codes.

ESC % Select User-Defined Set

Format:

ASCII code:	<ESC>	%	(n)
Decimal:	27	37	(n)
Hexadecimal:	1B	25	(n)

Explanation:

This code selects the user-defined set if n = 1 and the normal set if n = 0. ESC ! and ESC & are required to define the character set.

C.11 Dot Graphics

ESC K — Set Single Density Graphics Mode

Format:

ASCII code:

<ESC> K (n1) (n2) (data1) (data2) ... (data(d))

Decimal:

27 75 (n1) (n2) (data1) (data2) ... (data(d))

Hexadecimal:

1B 4B (n1) (n2) (data1) (data2) ... (data(d))

Explanation:

Turns on Single Density Graphics Mode. Printing 480 dots per 8-inch line. Where d is the total number of dots required n1 and n2 are calculated thus:

n1 = d MOD 256 and n2 = INT(d / 256).

and are followed by d data bytes.

ESC L — Set Double Density Graphics Mode

Format:

ASCII code:

<ESC> L (n1) (n2) (data1) (data2) ... (data(d))

Decimal:

27 76 (n1) (n2) (data1) (data2) ... (data(d))

Hexadecimal:

1B 4C (n1) (n2) (data1) (data2) ... (data(d))

Explanation:

Turns on Low-Speed Double Density Graphics Mode. Printing 960 dots per 8-inch line. Where d is the total number of dots required n1 and n2 are calculated thus:

n1 = d MOD 256 and n2 = INT(d / 256).

and are followed by d data bytes.

ESC Y Set High Speed Double Density Graphics Mode

Format:

ASCII code:

<ESC> Y (n1) (n2) (data1) (data2) ... (data(d))

Decimal:

27 89 (n1) (n2) (data1) (data2) ... (data(d))

Hexadecimal:

1B 59 (n1) (n2) (data1) (data2) ... (data(d))

Explanation:

Turns on High-Speed Double Density Graphics Mode. Printing 960 dots per 8-inch line. Similar to ESC L but cannot print two adjacent dots on the same row. Where d is the total number of dots required n1 and n2 are calculated thus:

n1 = d MOD 256 and n2 = INT(d / 256).

and are followed by d data bytes.

ESC Z Set Quadruple Density Graphics Mode

Format:

ASCII code:

<ESC> Z (n1) (n2) (data1) (data2) ... (data(d))

Decimal:

27 90 (n1) (n2) (data1) (data2) ... (data(d))

Hexadecimal:

1B 5A (n1) (n2) (data1) (data2) ... (data(d))

Explanation:

Turns on Quadruple Density Graphics Mode. Printing 1920 dots per 8-inch line. Where d is the total number of dots required n1 and n2 are calculated thus:

n1 = d MOD 256 and n2 = INT(d / 256).

and are followed by d data bytes.

ESC * — Select Graphics Mode

Format:

ASCII code:

<ESC> * (m) (n1)(n2) (data1) (data2) ... (data(d))

Decimal:

27 42 (m) (n1)(n2) (data1) (data2) ... (data(d))

Hexadecimal:

1B 2A (m) (n1)(n2) (data1) (data2) ... (data(d))

Explanation:

Select Graphics Mode where m is mode 0 to 6. Where d is the total number of dots required n1 and n2 are calculated thus:

n1 = d MOD 256 and n2 = INT(d / 256).

and are followed by d data bytes.

ESC ? — Reassign Graphics Mode

Format:

ASCII code:	**<ESC>**	**?**	**(s)**	**(n)**
Decimal:	**27**	**63**	**(s)**	**(n)**
Hexadecimal:	**1B**	**3F**	**(s)**	**(n)**

Explanation:

Change one graphics mode to another. The mode s is the ASCII code for the character K, L, Y, or Z which is to reassigned to a mode 0–6 as in the <ESC> * command. Details of the modes are given on page 83.

Format:

ASCII code:

<ESC> ^ (m) (n1) (n2) (data1) (data2) ... (data(d))

Decimal:

27 94 (m) (n1) (n2) (data1) (data2) ... (data(d))

Hexadecimal:

1B 5E (m) (n1) (n2) (data1) (data2) ... (data(d))

Explanation:

Turns on 9-Pin Graphics Mode. Where m defines density of print (0 for single and 1 for double) and d is the total number of dots required n1 and n2 are calculated thus:

n1 = d MOD 256 and n2 = INT(d / 256).

and are followed by two times d data bytes. The printer expects two data items for each column of print.

C.12 Miscellaneous Character Codes

CR — Carriage Return

Format:

ASCII code:	<CR>
Decimal:	13
Hexadecimal:	0D
Control:	Ctrl M

Explanation:

Prints the data in the buffer and returns the print head to the left margin. A line feed may also be added if either SW1-3 is ON or the AUTO FEED XT line on the parallel printer interface is held "LOW".

BEL — Bell Character

Format:

ASCII code:	<BEL>
Decimal:	7
Hexadecimal:	7
Control:	Ctrl G

Explanation:

Sounds the LX-80 buzzer for a quarter of a second.

DEL — Delete Character

Format:

ASCII code:	<DEL>
Decimal:	127
Hexadecimal:	7F

Explanation:

Deletes the previous character in the buffer unless that character has already been printed. It cannot be guaranteed to function if italics are being printed.

Format:

ASCII code:	<**CAN**>
Decimal:	**24**
Hexadecimal:	**18**
Control:	**Ctrl X**

Explanation:

Deletes all data on the same line ahead of this character.

Appendix D
The DIP Switches

Whereas it is possible to change various functions temporarily using control codes or <ESC> sequences, it is frequently more convenient to have the printer defaults set in a particular configuration when the printer is switched on. There are several tiny switches called DIP (for Dual In-Line Package) switches on the back of the LX-80 printer. They control a number of important printer functions such as page length, the international character set and NLQ or draft mode printing. For most uses they can be left as they were set at the factory, but you may need to change some settings to suit your computer system or the type of work you are doing with the LX-80.

The design of the LX-80 gives you easy access to the switches. You can see them in a pair of recesses on the back of the printer as shown in Figure D-1.

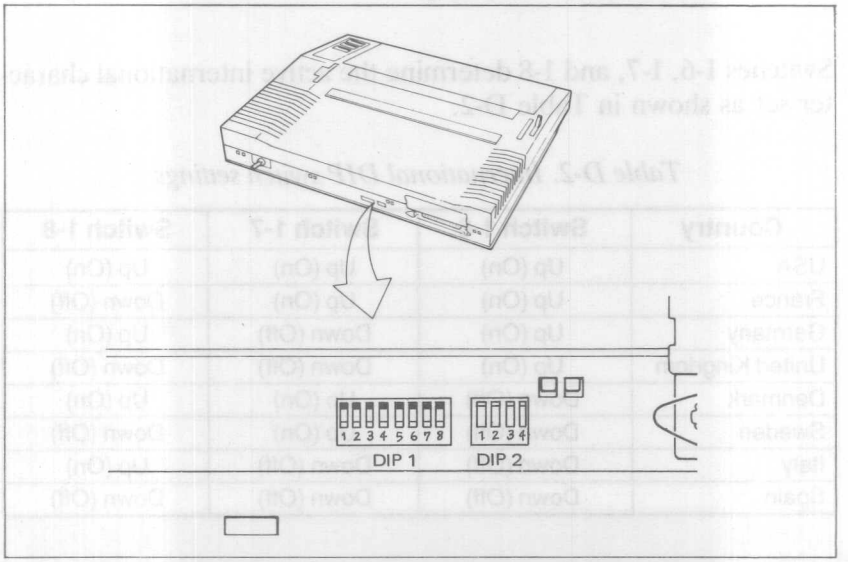


Figure D-1. DIP switch location

Before changing any of the switches, turn the power OFF (with the switch on the right side of the printer). Any changes made while the power is on will be ignored until you turn the printer off and back on or send the reset sequence <ESC> @.

Table D-1 shows the functions of all the switches. An explanation of their function follows on the next page.

Table D-1. DIP switch functions

Switch 1

No.	UP (ON)	Functions	DOWN (OFF)
1-8	See Below	International character set	
1-7	See Below	International character set	
1-6	See Below	International character set	
1-5	Inactive	Paper-out sensor	Active
1-4	12-inch	Form length	11-inch
1-3	Active	Cut-sheet feeder	Inactive
1-2	NLQ	NLQ/draft	Draft
1-1	Condensed	Print width	Pica

Switch 2

No.	UP (ON)	Functions	DOWN (OFF)
2-4	Silent	Beeper	Sounds
2-3	CR +LF	Automatic line feed	CR only
2-2	Active	Printer-select	Inactive
2-1	Ø	Slashed zero	0

Note: The shaded boxes show the factory settings.

Switches 1-6, 1-7, and 1-8 determine the active international character set as shown in Table D-2.

Table D-2. International DIP switch settings

Country	Switch 1-6	Switch 1-7	Switch 1-8
USA	Up (On)	Up (On)	Up (On)
France	Up (On)	Up (On)	Down (Off)
Germany	Up (On)	Down (Off)	Up (On)
United Kingdom	Up (On)	Down (Off)	Down (Off)
Denmark	Down (Off)	Up (On)	Up (On)
Sweden	Down (Off)	Up (On)	Down (Off)
Italy	Down (Off)	Down (Off)	Up (On)
Spain	Down (Off)	Down (Off)	Down (Off)

The use of international sets is discussed in Chapter 6. The characters which change when the DIP switches are reset are shown in Table 6-1.

Switch 1-5 controls the paper-out sensor. When it is up (ON), the detector is inactive, causing printing to continue even when the printer is out of paper. When it is down (OFF), the printer stops when the end of the paper passes the paper-out sensor. Some computer systems ignore the setting of this switch. See Appendix F.

Switch 1-4 selects the paper length. When it is down (OFF), the length is 11″; when it is up (ON), the length is 12″.

Switch 1-3 controls the optional cut-sheet feeder. When it is up (ON), the cut-sheet feeder is enabled. When it is down (OFF), the cut-sheet feeder is disabled.

Switch 1-2 selects draft or Near Letter Quality mode. When it is up (ON), the printer prints in the NLQ mode. When it is down (OFF), it prints in the draft mode. If the switch is off, you can still use the NLQ mode by using SelecType or an <ESC> code sequence.

Switch 1-1 selects condensed or pica printing. Up (ON) is condensed; down (OFF) is pica. Regardless of the setting, you can still select condensed and all of the other modes with SelecType and with <ESC> codes.

Switch 2-4 enables the beeper to sound when it is down (OFF); when it is up (ON), the beeper cannot sound.

Switch 2-3 controls line feeds. When it is up (ON), the LX-80 performs an automatic line feed with each carriage return; when it is down (OFF), the computer system must send the line feeds.

If your printing has an extra space between lines, turn the switch down (OFF). If all the lines of your printing are on top of each other, turn the switch up (ON). This switch enables the LX-80 to match computer systems which send a line feed whenever they send a carriage return and those which only send a carriage return. You may also find that even if you set the switch down (OFF) the lines are still double spaced. This is due to the interface cable between the computer and LX-80 overriding the DIP switch. The solution is to break the connection to pin 14. Consult your dealer if this is the case and you do not understand how to do this yourself.

Switch 2-2 selects the printer. When it is up (ON), the printer cannot be deactivated by software codes. When it is down (OFF), the printer is inactive until it receives the proper software code. The code for selection is ASCII code 17 (<DC1>) and for deselection is ASCII code 19 (<DC3>). Unless you understand this function or your computer or software manual tells you how to use it, leave the switch down (OFF).

Switch 2-1 controls the printing of zeros. When it is up (ON), the zeros are slashed (Ø); when it is down (OFF), they are not (0).

Appendix E
Using the Optional Tractor Unit

The optional tractor unit allows you to use continuous paper with pin feed holes along the sides. The unit is adjustable so that the continuous paper can be any width from 4 to 10 inches.

Printer Location

When you use the tractor and continuous paper, put your LX-80 where the paper can flow freely in and out of the printer. Use a printer stand or any other arrangement that fits your working area. Make sure that the paper coming out of the printer does not interfere with the paper going in and that the paper going in does not catch on the printer cable. Because of the cable, it is usually best for the paper that feeds into the printer to be stacked somewhat behind the printer instead of directly beneath it. Two possible setups are shown in Figures E-1 and E-2.

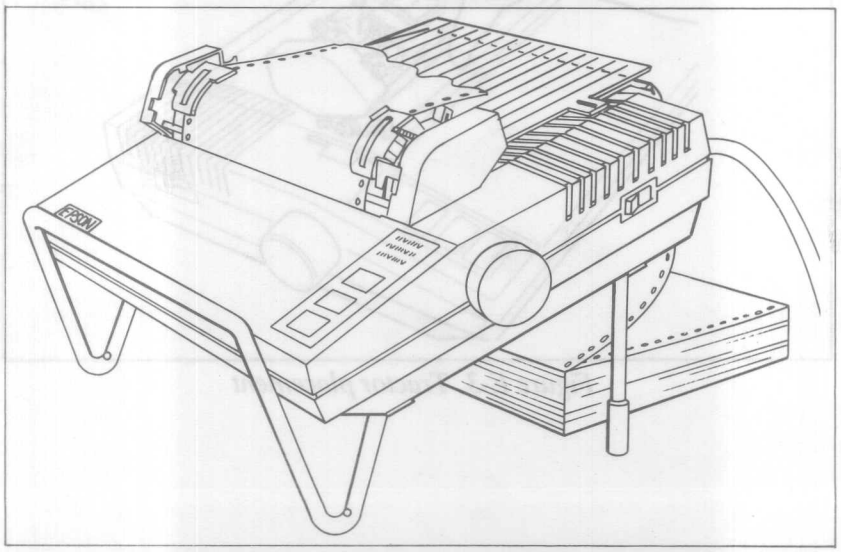


Figure E-1. Continuous paper with printer stand

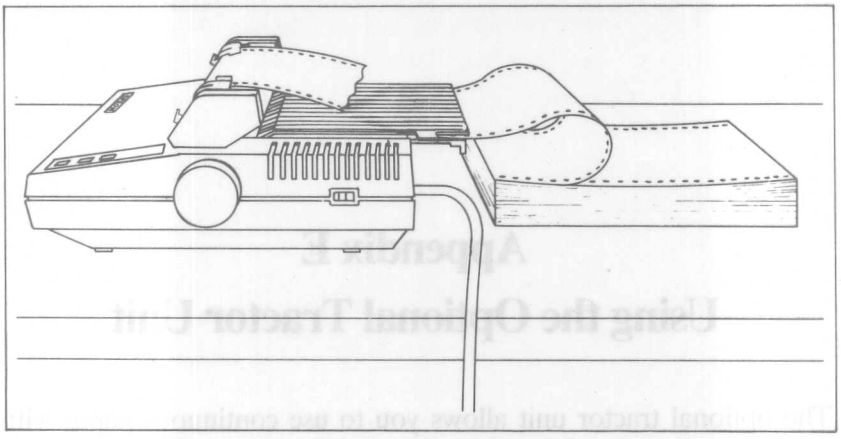


Figure E-2. Continuous paper without stand

Tractor Unit Installation

To install the removable tractor unit, first pull the friction lever toward the front of the printer. Then hold the tractor with the gears to the right as shown in Figure E-3.

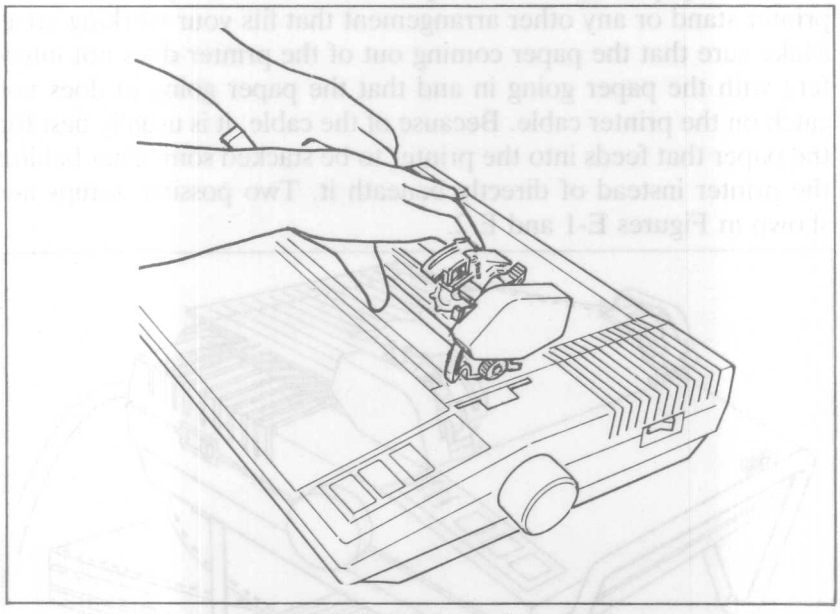


Figure E-3. Tractor placement

In each tractor slot are two pegs that fit into the notches on the tractor fittings. Tilt the tractor back so that the rear notches fit over the rear pegs. Then tilt the unit forward until it clicks into place. It is as easy as that.

Now install the paper separator and pull out the paper guide as shown in Figure E-4. Fit the notches in the bottom corners of the separator over the pins at the front of the paper slot. The separator keeps the paper that is coming out of the printer from being pulled back in. Pull out the paper guide at the back of the printer. This guide helps keep the incoming paper from catching on the printer cable.

NOTE: THIS GUIDE SHOULD NOT BE USED AS A CARRYING HANDLE.

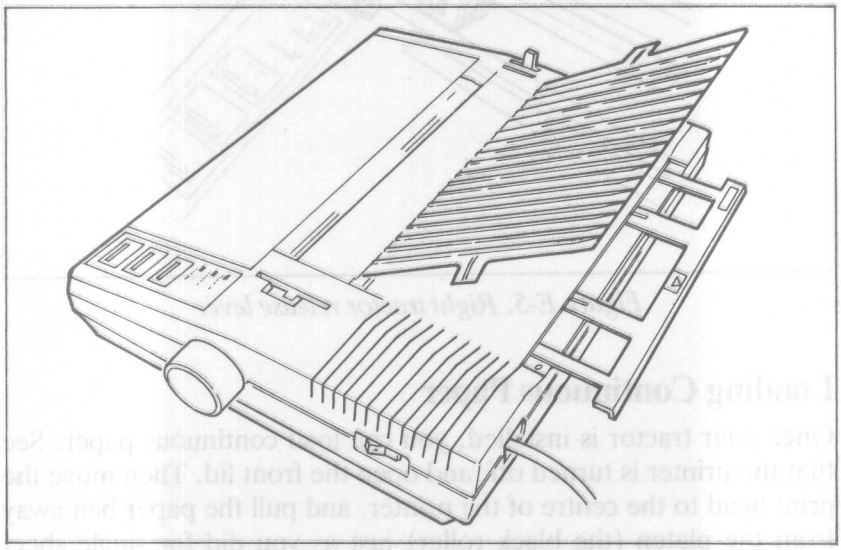


Figure E-4. Paper separator and paper guide

When you want to use single sheet paper in the LX-80, you can remove the tractor unit quite easily. Push back the two tractor release levers as shown in Figure E-5, tilt the unit backwards, and lift it up.

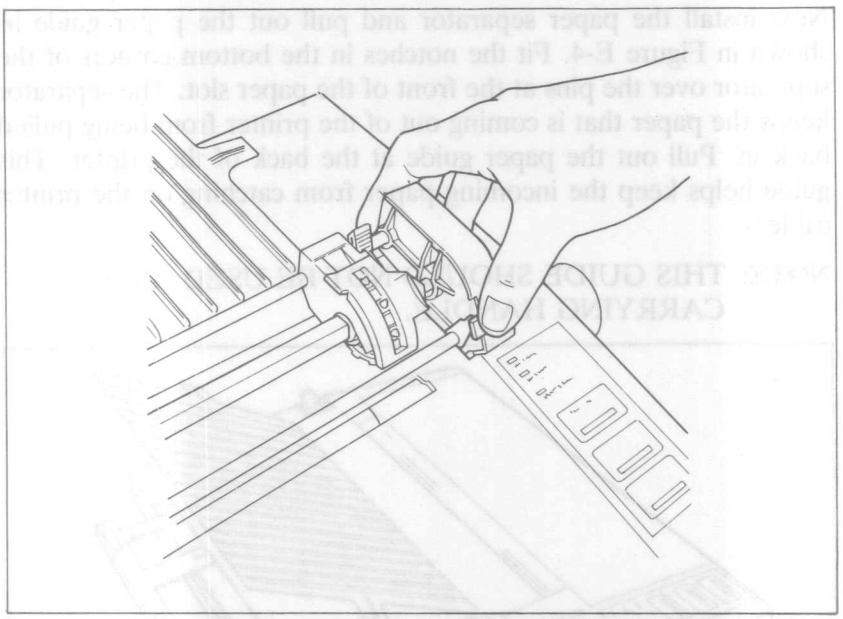


Figure E-5. Right tractor release lever

Loading Continuous Paper

Once your tractor is installed, you can load continuous paper. See that the printer is turned off, and open the front lid. Then move the print head to the centre of the printer, and pull the paper bail away from the platen (the black roller) just as you did for single sheet loading. (Look back at Figure 1-7 if you need to check on the names of any of these parts.)

Now, using Figure E-6 as your guide, pull the locking levers forward so that you can move the pin feed holders at the left and right. Put the left holder approximately 3/4 of an inch from the extreme left position and then push the locking lever back to lock that holder in place. Leave the other holder unlocked.

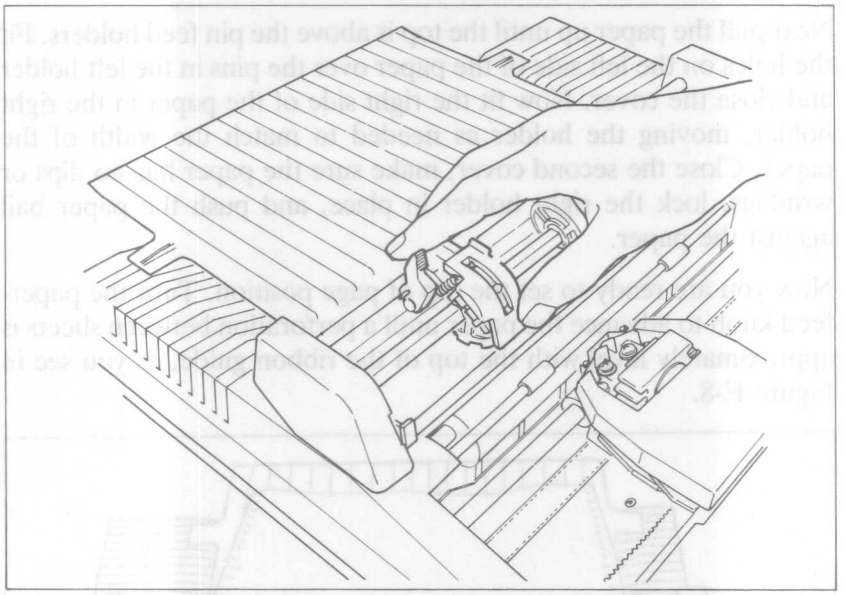


Figure E-6. Pin feed holder adjustment

Next, open the pin feed covers as shown in Figure E-7 and feed the paper under the paper separator and into the paper slot. Push the paper through until it comes up between the ribbon guide and the platen.

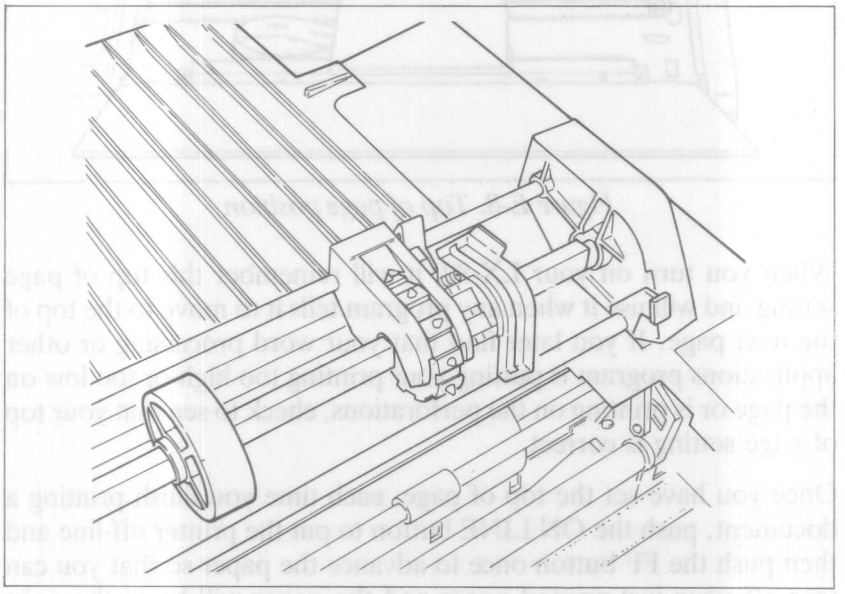


Figure E-7. Open pin feed cover

Next pull the paper up until the top is above the pin feed holders. Fit the holes on the left side of the paper over the pins in the left holder and close the cover. Now fit the right side of the paper in the right holder, moving the holder as needed to match the width of the paper. Close the second cover, make sure the paper has no dips or wrinkles, lock the right holder in place, and push the paper bail against the paper.

Now you are ready to set the top of page position. Turn the paper-feed knob to advance the paper until a perforation between sheets is approximately level with the top of the ribbon guide, as you see in Figure E-8.

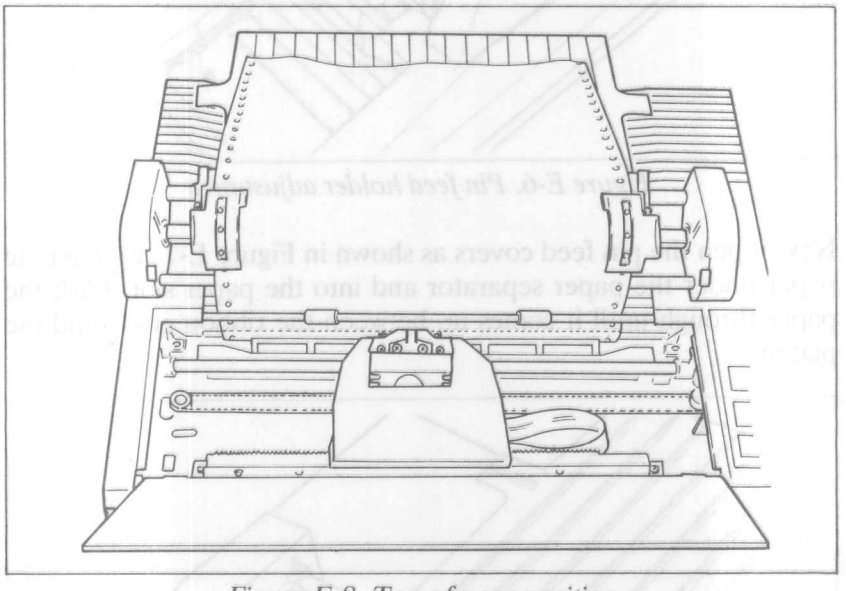


Figure E-8. Top of page position

When you turn on your LX-80, it will remember this top of page setting and will use it when any program tells it to move to the top of the next page. If you later find that your word processing or other applications program is putting your printing too high or too low on the page or is printing on the perforations, check to see that your top of page setting is correct.

Once you have set the top of page, each time you finish printing a document, push the ON LINE button to put the printer off-line and then push the FF button once to advance the paper so that you can tear off your just-printed pages and the paper will be in the right position to begin the next document.

Appendix F
Troubleshooting and Advanced Features

This appendix approaches troubleshooting from several directions. The first section matches solutions with some common general problems. Other sections cover beeper error warnings, hexadecimal data dumping, coding and 7-bit solutions, and specific solutions for several popular personal computer systems.

Problem/Solution Summary

Setting print styles

If you cannot change to condensed print, cancel emphasized. It has priority over condensed.

Tabbing

If horizontal tabs will not work and you are also setting the margin, set margins before setting the tabs, not after.

If horizontal tabs do not work, it may be that your computer will not allow the ASCII code 9 to be sent to the printer, or it may be interpretting the ASCII code 9 as a tab command, but substituting a series of spaces instead. This is likely to happen with CP/M-based machines. There may be other computers which also have problems because they cannot send the ASCII code 9. Look under the section on your computer.

If horizontal tabs are incorrect and you have changed pitch, remember that tabs are set to an absolute position according to the current print pitch. Changes in pitch do not affect the absolute position of the tabs across the page.

Graphics

If you find strange dot patterns appearing in the middle of your graphics, and at the end of the line of graphics there are text characters you did not intend, your computer may be sending a carriage return and line feed when you did not expect them. You may need to change the print width with a command like the WIDTH command in Microsoft BASIC. See your computer documentation.

Many computers have problems sending one or more of the codes between 0 and 13. Try to avoid these characters if possible. You may also be able to bypass the printer interface software which removes some of these codes. Where solutions are known they are given later in this appendix.

Seven-bit computers cannot use the eighth pin (128). If you have a 7-bit computer and any of your graphics data numbers is larger than 127, you will have to redesign the graphics. This is covered later in this appendix in greater detail than is possible here.

Be sure that no other commands or carriage returns come between the graphics command and its data. See Chapter 9.

If the printer "freezes" in graphics mode, you have sent a different number of data codes from the one you specified in the command.

The printer expects a certain number of pin patterns, determined by n1 and n2. It will wait patiently until the quota is fulfilled. Take extra care with 9-pin graphics mode since it requires two data bytes for each column of graphics.

Width problems

If you are not able to get a full page in width, check whether you have set the margins by switching off and on again. You may need to change the print width with a command like the WIDTH command in Microsoft BASIC. See your computer documentation.

If you are setting the width with a 7-bit computer, remember you are limited to widths of 0−127, 256−383, 512−639, etc. See the 7-bit subsection later in this appendix.

Problems with irregular darkness of printing

Check that the ribbon is seated correctly. It may need replacing if you have been using it for a long time or for a large amount of printing. It may occur in conjunction with the next problem.

Problems with paper feeding

If a self-adhesive label comes off the backing, it may stick behind the platen causing problems with paper feeding and printing. If this happens, take your LX-80 to a qualified service person or your dealer. Do not attempt to remove the label yourself.

Paper-out sensor

If you find that you are not able to deactivate the paper-out sensor with DIP switch 1-5 or <ESC> 8, the problem is due to the interface cable. Some software monitors printer cable pin 12 and will ignore both <ESC> 8 and the setting of DIP switch 1-5. The computer will stop printing until paper is put in the printer. It is possible to have your printer cable modified to take account of this problem. Please consult your dealer.

Computer hangs

You may find that the computer hangs when a particular piece of software is being run and the printer is off-line because you have set it so, or the printer has run out of paper. Some software monitors printer cable pin 11 and will halt because it thinks the printer is busy. It is not possible to modify the cable for this problem although the cable is signalling to the computer that the printer is off-line, because this would result in data being lost by the printer.

SelecType Solutions

If you have found that your software sends a resetting code and wipes out your SelecType settings, one of the following methods should help you find a way around the problem.

Method 1

Use the installation program for your software to remove the initialization code. See your software manual for details.

Method 2

Without using SelecType, give your program the command to print your document. Then, before the printing actually starts, give the command to stop printing. Now use SelecType to select the typestyle you want as in the following example for setting condensed mode:

1) Make sure that both the ON LINE and READY lights are on.
2) Press the ON LINE and FF buttons at the same time.
3) Press the ON LINE button four times (the code for condensed).

4) Press the FF button to set condensed.

5) Press the LF button to exit SelecType.

6) Press the ON LINE button.

Now give your printer the command to resume printing. If your example is now in condensed, you can use this same sequence each time you want to use SelecType. The procedure is not complicated. Once you have practiced it a few times, you will have fingertip control of your printing.

Method 3

Another method that may work with your software is to give the print command with the printer turned OFF. If at this point your screen gives you a message that your printer is off-line and tells you to press a certain key to re-try the printing after the printer is on, you may be able to turn on the printer and use SelecType before you press the key to signal that you want to re-try printing. Try turning on the printer and using SelecType as outlined above. Once you have selected your print function and put the printer back on-line by pressing the ON LINE button once, give your computer system the signal to resume printing.

Method 4

This is a variation of Method 3. Try giving the print command for your program and then pressing the ON LINE button to take the LX-80 off-line before printing actually starts. Then follow the procedure in Method 3.

Cancelling Functions with SelecType

If you want to cancel the modes you have set with SelecType, you can turn your printer off and back on with the power switch on the right side of the printer. This cancels all SelecType settings, returns your LX-80 to its defaults, resets the top of page, and empties the contents of the buffer, including any user-defined characters that you may have put there.

Occasionally you may wish to cancel one or more modes with SelecType instead of resetting the printer with the power switch. To cancel all modes controlled by SelecType, simply enter SelecType mode and then press the FF button without pressing the ON LINE button. (This is the zero code from Table 2-1.) This is useful when you make a mistake while setting codes and want to start over again, and it does not interfere with top of page, user-defined characters,

or other items that are not controlled by SelecType. It will set you in pica mode, and not NLQ if you have set this to be the default. Make sure you reset to NLQ if this is what you want.

If you do make a mistake while using SelecType, just press the LF button to turn off SelecType and then turn it on again and press the FF button before you press the ON LINE button.

In fact, you may prefer to use this method with the FF button to cancel any previous SelecType setting each time you use SelecType rather than switching off. If you want to be absolutely certain that no previous settings interfere with your use of SelecType, always press the FF button once immediately after you enter SelecType mode. For this procedure, after you press the ON LINE and FF buttons to turn on SelecType, press the FF button once, and then make and set your selection or selections as outlined in Chapter 2.

You can also cancel individual modes with SelecType if you wish. You do this with the same procedure that sets them. When a mode is already set, selecting it again cancels it, as demonstrated in the example below.

Suppose that you have set emphasized and NLQ modes and then you decide that you don't want emphasized. You can either cancel all the modes and reset NLQ, or you can use the following steps to cancel emphasized and leave NLQ.

1) See that the ON LINE and READY lights are on. (Make sure that you do not touch the power switch and cancel all the modes.)

2) Press the ON LINE and FF buttons to enter SelecType.

3) Press the ON LINE button twice. (This is the code for emphasized.) Notice that the ON LINE light is blinking and that it is on more than it is off. This tells you that the emphasized mode is set.

4) Press the FF button once. Now the ON LINE light is still blinking, but it is off more than it is on. This tells you that the emphasized mode is not set.

5) Press the LF button once to leave SelecType mode.

6) Press the ON LINE button to put the printer on-line.

Now you have cancelled emphasized without affecting any other modes.

You may feel that this procedure is too complicated and prefer to cancel all the SelecType settings and then reset the ones you want. Use whichever method you prefer. If you want to cancel modes individually, remember to watch the ON LINE light. It blinks mainly on when a mode is set and mainly off when it is not.

Other software

For some software you may have to consult their manuals or your dealer to find out at what point the printer is reset. You will probably find some stage in the printing process after the resetting where you can use SelecType.

Some of these tests may seem to take too much time and trouble, but you need to do them only once. Then you will know exactly what you need to do each time you use SelecType. After you have done the SelecType procedure two or three times, it will become quick and easy.

Beeper Error Warnings

When the LX-80's beeper sounds, it usually indicates that the printer is out of paper. The beeper can also be sounded by any program that sends the ASCII 7 code and by certain error conditions in the printer itself.

If the printer beeps and stops printing when it is not out of paper, turn the printer off and check to see if the paper is loaded correctly. If the paper is loaded correctly, turn the printer back on and try to print again. If the printer beeps and does not print again, consult your dealer.

Data Dump Mode

The LX-80 has a special feature that makes it easy for experienced printer users to find the causes of problems. Called the data dump mode, it gives a printout of exactly which codes reach the printer.

Turn on this mode by turning on the printer while holding down the FF and LF buttons at the same time. The LX-80 will print the words "Data Dump Mode." Then, when you send data to the printer, the LX-80 prints it in a special way. Each line is printed in three parts: a line number (four digits), the hexadecimal codes (up to 16 numbers) of the characters sent, and a guide section (16 characters at the end of each line except the last).

The hexadecimal numbers are the codes received by the printer. The guide section interprets the codes where possible in normal characters. Each character in the guide section corresponds to one of the codes. If the code is for a printable character, that character is printed. If the code is for a non-printable character, such as the <ESC> code or the code for a line feed or carriage return, a dot is printed.

Therefore, if you ran the following BASIC program while your LX-80 was in the data dump mode, you would get the printout shown below it. The printer will print all but the last line and then stop. You will have to press the ON LINE button to make the LX-80 print the last line.

```
10 FOR X=70 TO 73
20 LPRINT CHR$(X): NEXT X
30 LPRINT CHR$(27)"E"
40 LPRINT "Sample text"
50 LPRINT CHR$(27)"@"
```

```
Data Dump Mode
0000 46 0D 0A 47 0D 0A 48 0D 0A 49 0D 0A 1B 45 0D 0A   F..G..H..I...E..
0001 53 61 6D 70 6C 65 20 74 65 78 74 0D 0A 1B 40 0D   Sample text...@.
0002 0A
```

You can consult Appendix A or the Quick Reference Card to see the meaning of the hexadecimal codes. The following explanation of the first line will help you to understand what is happening.

The first code in line 0000 is hex 46, which is the same as decimal 70, the code for the letter "F". The "F" is printed in the first position in the guide section. Then, because there is no semicolon in line 20, MBASIC sends a carriage return and a line feed, hex codes 0D and 0A. Each of these is represented by a dot in the guide section. The program then sends the hex codes 47, 48, and 49, corresponding to decimal 71, 72 and 73 with each followed by a carriage return and line feed.

When the program gets to line 30, it sends <ESC> E and a carriage return and line feed. These are hex codes 1B, 45, 0D, and 0A, which are represented in the guide section by a dot, an "E", and two more dots.

Some computer systems change one or more codes when sending them from BASIC to the printer. The ability of the LX-80 to dump in hexadecimal lets you determine which codes are creating problems for your system.

Use Appendix A to translate any character codes from hexadecimal if the guide part of the line is not sufficiently helpful.

A hex printout of a program shows you exactly what the printer is receiving, regardless of what the computer is sending. The following test program lets you check to see what codes, if any, are problems for your computer system.

```
10 FOR X=0 TO 255
20 LPRINT CHR$(X);
30 NEXT X
```

Put the printer in data dump mode and then RUN the program. Remember to press the ON LINE button to make the LX-80 print the final line. Then compare your printout with the list of hex codes in order in the middle columns of page A-2 in Appendix A. If any are skipped or repeated, you will know that your BASIC language changes some codes before it sends them to the printer.

For example, in the line below, which is the first line of the printout of the test program run on a QX-10, you can see that in this case MBASIC changes hex 09, which is the code for horizontal tabbing, to several 20s, the code for a space. Therefore, you know that if you use this system, you must be careful about sending a decimal 9 (hex 09).

```
0000 00 01 02 03 04 05 06 07 08 20 20 20 20 20 20 20 ........
```

The data dumping capability can help you debug a program quickly. Appendices A to C will help you translate the hex codes to ASCII equivalents.

Coding Solutions

Once you've determined that a code creates problems for your printing, either by trial and error or by using the data dumping capability of the LX-80, you can start overcoming them.

Because each computer system deals with ASCII codes differently, it is impossible to provide solutions for all potential problems in one appendix. The following general approach suggests possible ways to handle them.

There are four common methods. First, you may be able to buy an alternative printer interface card for your system. This is the best solution for 7-bit system problems. See your computer dealer for advice about this.

The second approach is to use commercially available software that is specifically designed to overcome these coding problems. Consult your computer dealer or computer publications to see if a program for your computer system is available.

The third approach consists of avoiding the software that is changing the codes. On most computers you can send each code directly to the printer port. This bypasses the BASIC interpreter and avoids the interface.

Unfortunately, this process is also different for each computer system. Some of the specific computers mentioned may not be yours, but they may serve as models to enable you to know what to do. Consult your computer manual to determine if you can do the same on your system.

A fourth approach is to change the printer driver program in your system. This requires a knowledge of machine language and of the way your computer works. If you don't have this knowledge, your computer dealer may be able to help you or suggest someone who can.

The sample printer driver below (following the examples of POKEing codes). The idea is to pass the codes issued by a BASIC program directly to the printer.

POKEing codes

The TRS-80™ Model I version of the CHR$ function does not pass the values of 0, 10, 11, and 12 onto the printer correctly. Zero is a particular problem as it is very important to the <ESC> codes of the LX-80 printer.

These codes can be sent directly to the printer by POKEing them to a special memory location where they are immediately forwarded to the printer. The format is:

```
POKE 14312,N
```

where N is the decimal value of the code you wish to send to the printer. This works fine as long as the printer is ready to receive the data when you are ready to send it. On the Model I, the printer's readiness is assured if location 14312 contains a decimal 63.

It is best to first test to see if the printer is ready by using a line such as :

```
100 IF PEEK(14312)<>63 THEN 100
```

This puts the program into a continuous loop until the printer is ready to receive data. If data is sent while the printer is busy, it will be lost.

To show how similar these commands can be from system to system, here is the same concept implemented on the Apple® II Plus with the EPSON 8131 or 8132 interface cards:

```
100 IF PEEK(49601)>127 THEN 100
200 POKE 49296,N
```

The status of the printer is stored in location 49601 and the outgoing values are sent to 49296.

Special printer drivers

An even better (but more difficult) way to overcome these problems is to modify the printer driver so that the codes are passed correctly to the printer without any PEEKs or POKEs. If you do not want to write such a driver yourself, your computer dealer may be able to help you, or you may find one in a computer magazine, or from a computer user group.

The following printer driver, for instance, was written for the TRS-80 Model I by Bob Boothe and reprinted with the kind permission of *80 Micro* (Wayne Green Publishers). The program POKEs a machine-language printer driver program (stored in line 10) into memory, then tells the system where its new driver is located. Once you RUN the program, all codes sent by any BASIC program are sent directly to the printer—including 0s, 10s, and 12s.

```
10 DATA 21E837CB7E20FC211100397E32E837C9
20 READ B$: A=16571
30 FOR P=1 TO LEN(B$) STEP 2
40 B=ASC(MID$(B$,P,1)) - 48
50 IF B>9 THEN B=B - 7
60 T=ASC(MID$(B$,P + 1,1)) - 48
70 IF T>9 THEN T=T - 7
80 POKE A,B*16 + T
90 A=A+1
100 NEXT P
110 POKE 16422,187
120 POKE 16423,64
```

This driver will also work on the TRS-80 Model III—with one change in line 10: change 32E837 to D3FB.

Solutions for 7-Bit Systems

The BASIC language on some computers can only send seven bits to the printer at one time, even though the machine language may be able to send eight. (The Apple II Plus is a case in point). On such computers, the CHR$ function cannot send the entire range of ASCII codes (0-255) to the printer; it can send only the lower half (0-127).

To find out whether your system is an 8-bit system, capable of generating all 256 ASCII codes, enter this simple test:

```
10 FOR X=160 TO 254
20 LPRINT CHR$(X);
30 NEXT X
```

If you get italic characters when you RUN this, you are using an 8-bit system.

If you have a 7-bit system, you need to understand what happens to the control codes you send. The LX-80 automatically interprets these codes the way your system sends them—as the lower half of the range. There is something you may be able to do when you want to send the upper half (128-255): have your program convert all codes outside of the active range to their equivalent in the upper half by adding 128 to them.

The problems that are associated with 7-bit systems include:

- Limitations on width in graphics mode
- Inability to use the top pin for graphics mode

User-defined characters cannot be printed with the top eight pins (the standard position for most characters). Also eight pins cannot be used in defining characters.

Remember that the best solution usually is to use an interface that can send eight bits to the printer.

Solutions for Specific Systems

The next subsections illustrate dealing with interface problems on several types of computers.

Applesoft BASIC solutions

Applesoft BASIC does not use PRINT to send data to the screen and LPRINT to send data to the printer as MicroSoft BASIC does. You have to issue the command PR#1 to switch the printer on and PR#0 to switch it off.

If one of the programs in this manual contains an INPUT statement or a PRINT statement, there will be a message that should go to the screen before anything is sent to the printer. In these programs, leave the first lines as they are and after the INPUT and/or PRINT statements, add a line that states PR#1. Then change all the instances of LPRINT to PRINT and put a line that states PR#0 at the end of the program.

Apple II solutions

There are two types of problems that you who own Apple II computers will need to address. The first is that the Apple II is an 8-bit computer, but works mainly with 7 bits. The eighth bit is often set permanently to a 1 (ON). This means that most printer interfaces only handle 7 bits, because of the need to remove the 1 from the eighth bit. The second type of problem is that the interface normally has its own use for ASCII code 9. These problems restrict you in sending graphics data.

Should you need an 8-bit system, the simplest solution is to purchase a new printer interface card from your computer dealer. Such a card is available for the Apple II.

You can POKE codes to memory as discussed above, you can write your own printer driver, or you can avoid the types of programs that require eight bits. A routine to POKE codes to the memory of an Apple II Plus is given in the POKEing codes subsection.

The Apple II uses ASCII CODE 9 to "initialize" the printer. This code and the following character or characters are intercepted by the printer interface card and used to change modes. For example, you can set the column width to 80 and simultaneously divert all output to the printer instead of to the screen by sending the following lines:

```
PR#1
PRINT CHR$(9)"8ØN"
```

The CHR$(9)"80N" code directs all subsequent output to the printer, up to 80 characters per row. You can cancel this by typing:

```
PRINT CHR$(9)"I"     or    PR#O
```

The problem is that the LX-80 uses CHR$(9) to activate horizontal tabulation and can also use it in graphics programs. When you send this code, however, your system will interpret it as a printer initialization code and the program will not work properly. In these cases the interface manual will normally tell you how to change the initialization character to another one. If you are using a word processor you should not have much trouble, as the software will normally handle these problems.

With the latest Apple software such as the "Appleworks" package or anything running under prodos, you may find your printer card will not allow you to print anything to the LX-80. In this case consult your dealer as the ROM on the interface card may need updating.

TRS-80™ solutions

A routine to POKE codes to the memory of a Model I is given in the POKEing codes subsection. A special printer driver for either the Model I or the Model III is shown in the Special printer drivers subsection. One of those methods should solve any problems with the programs in this manual.

IBM-PC™ solutions

There are two problems in using the IBM Personal Computer BASIC to drive a printer. First, the IBM-PC BASIC inserts a carriage-return/line-feed (CR-LF) after each 80 characters you send it. Second, it adds an LF to each CR in an LPRINT statement.

Here is the way to adjust the width when it is the only problem. Tell the computer that the print line is wider than 80 characters with this WIDTH statement:

```
WIDTH "LPT1:", 255
```

The 255 is a special number that prevents the computer system from inserting a CR-LF into the line. Unless, of course, there is one in your program.

The extra line feed—CHR$(10)—that accompanies each carriage return—CHR$(13)—is no problem except when you need to use CHR$(13) in a graphics program. Getting rid of the extra

CHR$(10) is rather complicated. First you open the printer as a random file:

```
OPEN "LPT1:" AS #1
```

Although this allows you to send any code to the printer, you can no longer use the LPRINT command. Use a PRINT #1 instead.

```
PRINT #1, "Now I can print anything"
```

If you want to print more than 80 characters per line in a graphics program, you must therefore change your opening statement to include the appropriate WIDTH statement:

```
OPEN "LPT1:" AS #1 : WIDTH #1, 255
```

And for the programs in this manual, don't forget to use PRINT #1 wherever we use LPRINT.

This won't work for those of you who have the original release of the Disk Operating System (DOS 1.0). It can't run a printer like a file. IBM has, however, issued a free update (DOS 1.05); take a disk to your dealer to get your copy.

Another printer problem with DOS 1.0 is that it doesn't send CHR$(7) to the printer; it just rings the computer's bell. This has also been corrected in subsequent versions.

QX-10 multifont CP/M solutions

There are two problems you may experience when using the Multifont CP/M system. Firstly, it is not possible to send control characters in the range 0-31 without first giving the BIT ON command in Multifont BASIC. You may have trouble in sending control characters using software in the CP/M environment, not just BASIC. In this case your dealer will be able to tell you how to patch the program, or give you a short COM file to run before you run the applications program.

When you configure your system you should take the FX-80 option in the CONFIG program. This may cause you problems in some cases because the QX-10 will automatically send a carriage return and line feed after 80 characters. You can extend this to 100 characters by taking the FX-100 option in CONFIG. If you want more, you will have to go back to your dealer to obtain a patch to CP/M. In Multifont BASIC, the WIDTH LPRINT 255 will overcome this problem.

BBC BASIC solutions

The command to send the next character to the printer port is VDU 1. However, you can also switch the printer port on by giving the command VDU 2, then use PRINT and all characters will print both on the screen and the printer. If one of the programs in this manual contains an INPUT statement or a PRINT statement, there will be a message that should go to the screen before anything is sent to the printer. In these programs, leave the first lines as they are and after the INPUT and/or PRINT statements, add a line that states VDU 2. Then change all the instances of LPRINT to PRINT and put a line that states VDU 3 at the end of the program. This switches all output to screen only. When using the VDU 1 command to send codes to the LX-80, remember a "1" has to be used after EACH character you wish to output. Thus the command to set enlarged characters until switched off (<ESC> W1) requires the sequence:

VDU 1,27,1,87,1,1

Appendix G
Printer Maintenance

Always

Always keep your printer in a safe and clean location. Keep it away from:

Dust and grease

Heaters and furnaces. Safe temperature range is 5°C (41°F) to 35°C (95°F)

Now and Then

Clean particles and dust from the printer every so often with a soft cloth or brush. Use a mild cleanser for the outside framework and, after removing the ribbon cassette, denatured alcohol for the inside.

See your Epson dealer for replacement ribbon cassettes.

Appendix H
Technical Specifications

Printing

Printing method ..... Impact dot matrix
Printing speed ..... 100 characters per second
Paper feed speed ..... Approximately 150 ms/line (at 1/6 inch/line)
Approximately 100 ms/line (during continuous line feed)
Printing direction ..... Bidirectional, logic seeking
Unidirectional (left to right) in graphics mode
Character set ..... 96 Roman characters
96 italic characters
32 international characters
32 italic international characters
32 graphic characters
96 NLQ characters
32 NLQ international characters

Character size

Mode	Width inches	Height inches
Pica	.083 in	.122 in
Pica enlarged	.166 in	.122 in
Elite	.059 in	.122 in
Elite enlarged	.118 in	.122 in
Condensed	.041 in	.122 in
Condensed enlarged	.083 in	.122 in
Super/Subscript		.063 in

Line spacing ..... Default is 1/6 inch. Programmable in increments of 1/72 inch and 1/216 inch

Characters per line:

	Maximum characters per line
Pica	80
Pica expanded	40
Elite	96
Elite expanded	48
Compressed	132*
Compressed expanded	66*
Compressed elite	160

*137 if right margin is changed.
*68 if right margin is changed.

Paper

	Paper width	Paper feed
Pin-feed	4″ to 10″	Tractor feed with optional tractor
Single sheet	up to 8.5″	Friction feed
Number of copies	One original plus one copy; total thickness not to exceed 0.005″	

Printer

Ribbon	Cassette ribbon, black
MCBF	3 million lines (excluding print-head life)
Print head life	100 million characters

Dimensions and Weight

Height	3.3 in
Width	16.6 in
Depth (without paper separator)	12.4 in
Weight	11.5 lbs
Power	120 VAC ± 10% (US models) 220/240 VAC ± 10% (European models)
Power usage	70 volt-amperes maximum
Frequency	49.5 to 60.5 Hz

Environment

Temperature	Operating 5°C to 35°C (41°F to 95°F) Storage −30°C to 65°C (−22°F to 149°F)
Humidity	Operating 10% to 80% (no condensation) Storage 5% to 85% (no condensation)
Shock	Operating 1 G (less than 1 millisecond) Storage 2 G (less than 1 millisecond)
Vibration	Operating 0.25 G, 55Hz (maximum) Storage 0.50 G, 55Hz (maximum)
Insulation resistance	10 megaohms between AC power line and chassis
Dielectric strength	No trouble when 1 kilovolt (R.M.S.) 50 or 60 Hz is applied for more than 1 minute between AC power line and chassis

Interface

Interface	Centronics® compatible, 8-bit parallel
Synchronization	By externally supplied $\overline{\text{STROBE}}$ pulses
Handshaking	By $\overline{\text{ACKNLG}}$ or BUSY signals
Logic level	Input data and all interface control signals are compatible with TTL levels

Appendix I
The Parallel Interface

The LX-80 printer uses a parallel interface to communicate with the computer; this appendix describes it.

Connector pin assignments and a description of respective interface signals are shown in Table I-1.

Table I-1. Pins and signals

Signal Pin	Return Pin	Signal	Direction	Description
1	19	$\overline{\text{STROBE}}$	IN	$\overline{\text{STROBE}}$ pulse to read data in. Pulse width must be more than 0.5 microseconds at the receiving terminal.
2	20	DATA1	IN	These signal represent information of the 1st to 8th bits of parallel data, respectively. Each signal is at HIGH level when data is logical 1 and LOW when it is logical 0.
3	21	DATA2	IN	
4	22	DATA3	IN	
5	23	DATA4	IN	
6	24	DATA5	IN	
7	25	DATA6	IN	
8	26	DATA7	IN	
9	27	DATA8	IN	
10	28	$\overline{\text{ACKNLG}}$	OUT	Approximately 12-microsecond pulse. LOW indicates that data has been received and that the printer is ready to accept more data.
11	29	BUSY	OUT	A HIGH signal indicates that the printer cannot receive data. The signal goes HIGH in the following cases: 1) During data entry. 2) During printing. 3) When off-line. 4) During printer-error state.
12	30	PE	OUT	A HIGH signal indicates that the printer is out of paper.

Table I-1, continued

Signal Pin	Return Pin	Signal	Direction	Description
13	—	—	—	Pulled up to +5 volts through 3.3K ohm resistance.
14	—	$\overline{\text{AUTO FEED XT}}$	IN	When this signal is LOW, the paper is automatically fed 1 line after printing. (The signal level can be fixed to this by setting DIP switch 2-3 to ON.)
15	—	NC	—	Unused.
16	—	0V	—	Logic ground level.
17	—	CHASSIS GND	—	Printer's chassis ground, which is isolated from the logic ground.
18	—	NC	—	Unused.
19–30	—	GND	—	Twisted-pair return signal ground level.
31	—	$\overline{\text{INIT}}$	IN	When this level becomes LOW, the printer controller is reset to its power-up state and the print buffer is cleared. This level is usually HIGH; its pulse width must be more than 50 microseconds at the receiving terminal.
32	—	$\overline{\text{ERROR}}$	OUT	This level becomes LOW when the printer is in: 1) Paper-end state. 2) Off-line. 3) Error state.
33	—	GND	—	Same as for pins 19–30.
34	—	NC	—	Unused.
35	—	—	—	Pulled up to +5V through 3.3K ohm resistance.
36	—	$\overline{\text{SLCT IN}}$	IN	Data entry to the printer is possible only when this level is LOW; DIP switch 2-2 is set for this at the factory.

Notes:

1. The column heading "Direction" refers to the direction of signal flow as viewed from the printer.
2. "Return" denotes the twisted-pair return, to be connected at signal ground level. For the interface wiring, be sure to use a twisted-pair cable for each signal and to complete the connection on the return side. To prevent noise, these cables should be shielded and connected to the chassis of the host computer or the printer.
3. All interface conditions are based on TTL level. Both the rise and the fall times of each signal must be less than 0.2 microsecond.

4. Data transfer must be carried out by observing the $\overline{\text{ACKNLG}}$ or BUSY signal. (Data transfer to this printer can be carried out only after receipt of the $\overline{\text{ACKNLG}}$ signal or when the level of the BUSY signal is LOW.)
5. Under normal conditions, printer cable pins 11, 12, and 32 are activated when the paper-end condition is detected. The <ESC> 8 code disables pins 11 and 32, but not pin 12. Those computers that monitor pin 12 halt printing when the paper is out, making <ESC> 8 ineffective.

Data Transfer Sequence

Interface timing

Figure I-1 shows the timing for the parallel interface.

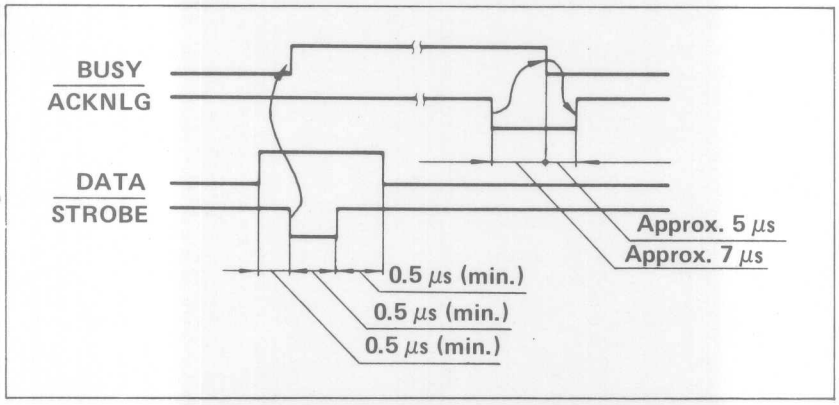


Figure I-1. Parallel interface timing

Signal relationships

Table I-2 shows the way data entry is handled in the on-line and off-line states by showing the relationships between seven signal sets.

Table I-2. Signal interrelations

On-Line	$\overline{\text{SLCT IN}}$	ERROR	BUSY	$\overline{\text{ACKNLG}}$	DATA ENTRY
OFF	HIGH/LOW	LOW	HIGH	Not generated	Disabled
ON	HIGH	HIGH	LOW/HIGH	Generated after data entry	Enabled*
ON	LOW	HIGH	Same	Same	Enabled (normal entry)

*When $\overline{\text{SLCT IN}}$ is at high level, data entry is enabled, but the input data will be disregarded until $\overline{\text{SLCT IN}}$ is at low level.

Note: $\overline{\text{ERROR}}$ status is assumed to rest only in off-line state, and the $\overline{\text{ERROR}}$ status does not always mean $\overline{\text{SLCT IN}}$.

INDEX

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

Z

EPSON®

Quick Reference

LX-80 Printer

Near Letter Quality Mode

<ESC> x 1	Turns NLQ mode ON.
<ESC> x 0	Turns draft mode ON.
<ESC> a	Activates NLQ justification modes.

Character Width (Pitch)

ASCII 15	Turns condensed mode ON.
ASCII 18	Turns condensed mode OFF.
ASCII 14	Turns one-line enlarged mode ON.
ASCII 20	Turns one-line enlarged mode OFF.
<ESC> M	Turns elite mode ON.
<ESC> P	Turns pica mode ON, elite mode OFF.
<ESC> W0	Turns either enlarged mode OFF.
<ESC> W1	Turns continuous enlarged mode ON.

Character Weight

<ESC> E	Turns emphasized mode ON.
<ESC> F	Turns emphasized mode OFF.
<ESC> G	Turns double-strike mode ON.
<ESC> H	Turns double-strike mode OFF.

Print Enhancement

<ESC> S0	Turns superscript mode ON.
<ESC> S1	Turns subscript mode ON.
<ESC> T	Turns either script mode OFF.
<ESC> −0	Turns underline mode OFF.
<ESC> −1	Turns underline mode ON.

Mode and Character Set Selection

<ESC> !	Master select.
<ESC> 4	Turns italic mode ON.
<ESC> 5	Turns italic mode OFF.
<ESC> @	Reset code.
<ESC> R	Selects an international character set.
<ESC> m	Selects and cancels special graphics characters.

Special Printer Features

ASCII 8	Backspaces.
<ESC> 25	Enables and disables optional cut-sheet feeder.
<ESC> <	Turns one-line unidirectional mode ON.
<ESC> U0	Turns continuous unidirectional mode OFF.
<ESC> U1	Turns continuous unidirectional mode ON.
<ESC> s0	Returns to normal speed.
<ESC> s1	Turns half-speed mode ON.

Line Spacing

<ESC> 0	Sets line spacing to 1/8-inch.
<ESC> 1	Sets line spacing to 7/72-inch.
<ESC> 2	Sets line spacing to 1/6-inch (default).
<ESC> A n	Sets line spacing to n/72-inch.
<ESC> 3 n	Sets line spacing to n/216-inch.
<ESC> J n	Produces an immediate one-time line feed of n/216-inch without a carriage return.

Forms Control

<ESC> 8	Turns the paper-out sensor OFF.
<ESC> 9	Turns the paper-out sensor ON.
<ESC> C 0	Sets the form length in inches.
<ESC> C	Sets the form length in lines.
<ESC> N	Turns variable skip over perforation ON.
<ESC> O	Turns skip over perforation OFF.

Page Format

ASCII 9 or 137	Activates horizontal tab.
ASCII 11	Activates vertical tab.
<ESC> D	Sets horizontal tab stops.
<ESC> Q	Sets the right margin.
<ESC> l	Sets the left margin.

User-defined Characters

<ESC> &	Defines characters in user RAM.
<ESC> :	Copies the character set from ROM to RAM.
<ESC> %	Activates ROM or RAM character set.

Dot Graphics

<ESC> *	Selects one of seven graphics densities.
<ESC> ?	Reassigns a graphics density.
<ESC> K	Turns single density graphics mode ON.
<ESC> L	Turns double density graphics mode ON.
<ESC> Y	Turns high-speed double density graphics mode ON.
<ESC> Z	Turns quadruple density graphics mode ON.
<ESC> ^	Turns 9-pin graphics mode ON.

SelecType Feature

Mode	Function	
0	Reset	ABCDEFGHIJKLMNopqrstuvwxyz
1	NLQ	ABCDEFGHIJKLMNopqrstuvwxyz
2	Emphasized	ABCDEFGHIJKLMNopqrstuvwxyz
3	Double-strike	ABCDEFGHIJKLMNopqrstuvwxyz
4	Condensed	ABCDEFGHIJKLMNopqrstuvwxyz
5	Elite	ABCDEFGHIJKLMNopqrstuvwxyz

ASCII Codes

Dec	Hex	CHR	Dec	Hex	CHR	Dec	Hex	CHR	Dec	Hex	CHR
0	00	NUL	64	40	@	128	80	Ç	192	C0	À
1	01	SOH	65	41	A	129	81	ü	193	C1	Á
2	02	STX	66	42	B	130	82	é	194	C2	Â
3	03	ETX	67	43	C	131	83	â	195	C3	Ã
4	04	EOT	68	44	D	132	84	ä	196	C4	Ä
5	05	ENQ	69	45	E	133	85	à	197	C5	Å
6	06	ACK	70	46	F	134	86	å	198	C6	Æ
7	07	BEL	71	47	G	135	87	ç	199	C7	Ç
8	08	BS	72	48	H	136	88	ê	200	C8	È
9	09	HT	73	49	I	137	89	ë	201	C9	É
10	0A	LF	74	4A	J	138	8A	è	202	CA	Ê
11	0B	VT	75	4B	K	139	8B	ï	203	CB	Ë
12	0C	FF	76	4C	L	140	8C	î	204	CC	Ì
13	0D	CR	77	4D	M	141	8D	ì	205	CD	Í
14	0E	SO	78	4E	N	142	8E	Ä	206	CE	Î
15	0F	SI	79	4F	O	143	8F	Å	207	CF	Ï
16	10	DLE	80	50	P	144	90	É	208	D0	Ð
17	11	DC1	81	51	Q	145	91	æ	209	D1	Ñ
18	12	DC2	82	52	R	146	92	Æ	210	D2	Ò
19	13	DC3	83	53	S	147	93	ô	211	D3	Ó
20	14	DC4	84	54	T	148	94	ö	212	D4	Ô
21	15	NAK	85	55	U	149	95	ò	213	D5	Õ
22	16	SYN	86	56	V	150	96	û	214	D6	Ö
23	17	ETB	87	57	W	151	97	ù	215	D7	×
24	18	CAN	88	58	X	152	98	ÿ	216	D8	Ø
25	19	EM	89	59	Y	153	99	Ö	217	D9	Ù
26	1A	none	90	5A	Z	154	9A	Ü	218	DA	Ú
27	1B	ESC	91	5B	[	155	9B	¢	219	DB	Û
28	1C	none	92	5C	\	156	9C	£	220	DC	Ü
29	1D	none	93	5D	]	157	9D	¥	221	DD	Ý
30	1E	none	94	5E	^	158	9E	₧	222	DE	Þ
31	1F	none	95	5F	_	159	9F	ƒ	223	DF	ß
32	20		96	60	`	160	A0	á	224	E0	à
33	21	!	97	61	a	161	A1	í	225	E1	á
34	22	"	98	62	b	162	A2	ó	226	E2	â
35	23	#	99	63	c	163	A3	ú	227	E3	ã
36	24	$	100	64	d	164	A4	ñ	228	E4	ä
37	25	%	101	65	e	165	A5	Ñ	229	E5	å
38	26	&	102	66	f	166	A6	ª	230	E6	æ
39	27	'	103	67	g	167	A7	º	231	E7	ç
40	28	(	104	68	h	168	A8	¿	232	E8	è
41	29	)	105	69	i	169	A9	⌐	233	E9	é
42	2A	*	106	6A	j	170	AA	¬	234	EA	ê
43	2B	+	107	6B	k	171	AB	½	235	EB	ë
44	2C	,	108	6C	l	172	AC	¼	236	EC	ì
45	2D	-	109	6D	m	173	AD	¡	237	ED	í
46	2E	.	110	6E	n	174	AE	«	238	EE	î
47	2F	/	111	6F	o	175	AF	»	239	EF	ï
48	30	0	112	70	p	176	B0	▒	240	F0	ð
49	31	1	113	71	q	177	B1	▓	241	F1	ñ
50	32	2	114	72	r	178	B2	│	242	F2	ò
51	33	3	115	73	s	179	B3	┤	243	F3	ó
52	34	4	116	74	t	180	B4	╡	244	F4	ô
53	35	5	117	75	u	181	B5	╢	245	F5	õ
54	36	6	118	76	v	182	B6	╖	246	F6	ö
55	37	7	119	77	w	183	B7	╕	247	F7	÷
56	38	8	120	78	x	184	B8	╣	248	F8	ø
57	39	9	121	79	y	185	B9	║	249	F9	ù
58	3A	:	122	7A	z	186	BA	╗	250	FA	ú
59	3B	;	123	7B	{	187	BB	╝	251	FB	û
60	3C	<	124	7C	¦	188	BC	╜	252	FC	ü
61	3D	=	125	7D	}	189	BD	╛	253	FD	ý
62	3E	>	126	7E	~	190	BE	┐	254	FE	þ
63	3F	?	127	7F	DEL	191	BF	└	255	FF	

Control Keys

Decimal	Hexadecimal	Control key
0	00	@
1	01	A
2	02	B
3	03	C
4	04	D
5	05	E
6	06	F
7	07	G
8	08	H
9	09	I
10	0A	J
11	0B	K
12	0C	L
13	0D	M
14	0E	N
15	0F	O
16	10	P
17	11	Q
18	12	R
19	13	S
20	14	T
21	15	U
22	16	V
23	17	W
24	18	X
25	19	Y
26	1A	Z